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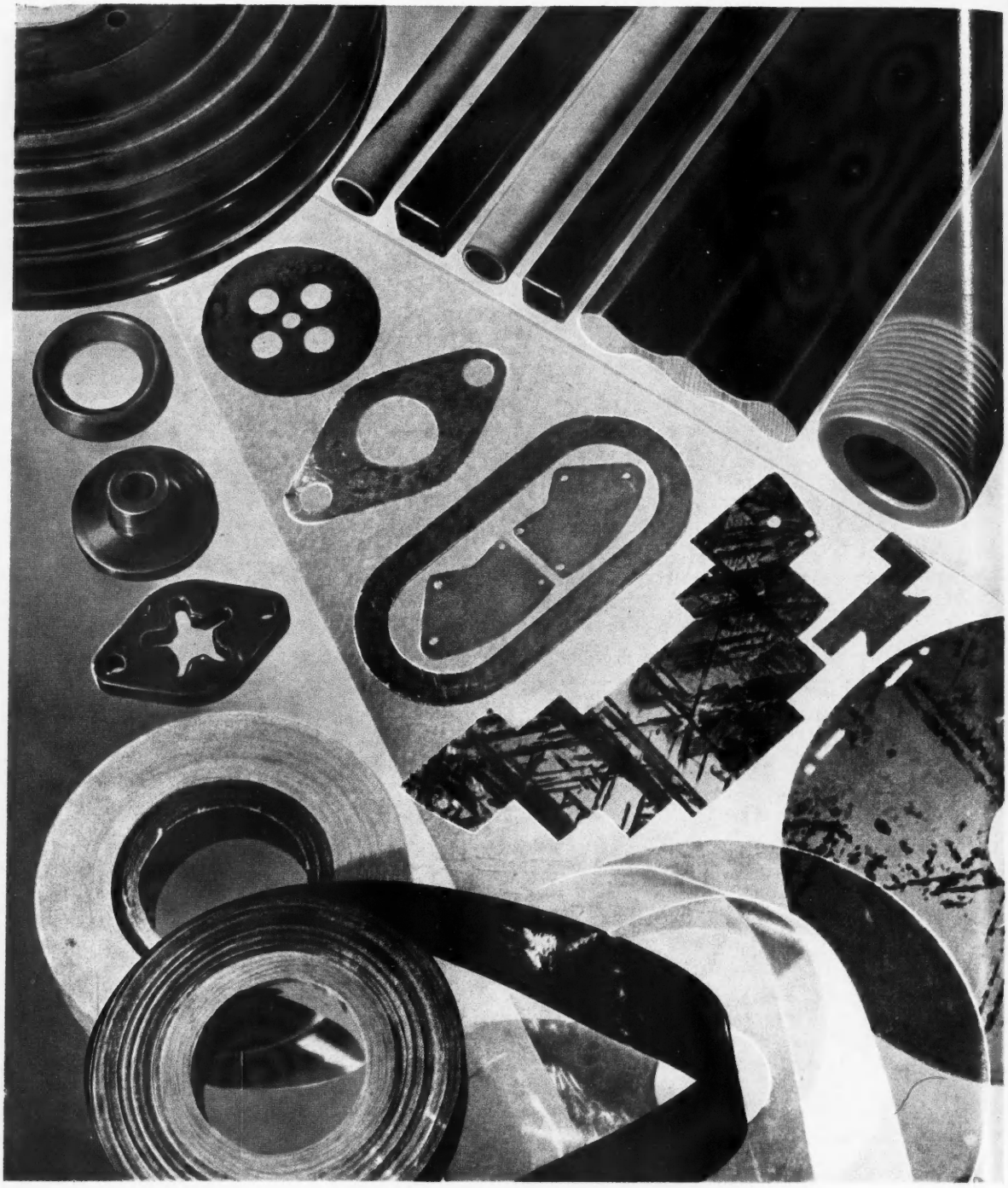

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ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
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1 JUNE 1956

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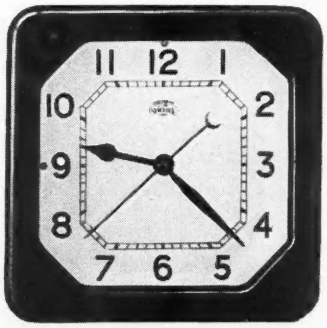

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ELECTRICAL REVIEW

1 June 1956 Vol. 158 No. 22 Established 1872

The Domestic Demand

IF any electrical people still have fears about the ability of electricity to compete with its rivals, solid fuel and gas, Mr. D. Bellamy's paper presented at the Torquay Convention should comfort them. Nor can it be doubted that electricity is advancing at a greater rate, although it has not yet reached the intensity at which it will be possible to absorb rising costs without further price increases.

Some fuel economists contend that electricity is too cheap; others that the domestic consumer is being subsidised by industry. It seems to be an axiom with the first group that the rise in the cost of electricity should be proportionate to that in other items of the cost-of-living index. They ignore the beneficial effect of improved load factor which, Mr. Bellamy shows, by rising from 31·8 per cent in 1937–38 to 42·1 per cent in 1954–55, kept the increase in the total cost per kWh sold down to 26 per cent although the running cost rose by 236 per cent. He also averred, however, that load factor must rise to 50·7 per cent if further increases are to be avoided.

Mr. Bellamy sorts out the various factors which enter into the costs of domestic and industrial supplies and comes to the conclusion that the effective increase between 1938 and 1955 was 62 per cent in the case of domestic charges and 64 per cent for industrial supplies. This does not prove that the industrialist was not subsidising the householder in 1938 but later in the paper the author demonstrates that the charges for domestic supplies in their relation to the cost of supply are, at present price levels, economic and essential to the development of the supply. That is, they must be such as to encourage increased use to improve load factor.

It is in the realm of space heating that electricity encounters the greatest controversy. Its peculiar advantages have made it the favourite for ancillary or occasional heating but at peak times the electric heater is not welcomed by the supply authorities. Mr. Bellamy admits that until further practical evidence is available about the results of off-peak heating methods continuous domestic electric heating cannot be advocated on purely economic grounds. He has hopes of the storage heater which is not yet available to domestic consumers. Cooking and water heating can best be done electrically; only inadequate publicity and adverse tax policy prevents the more rapid development of water heating but this, of course, applies equally to other applications.

In his conclusions Mr. Bellamy stresses the need for the electricity supply industry to make adequate supplies available if the use of electricity is to expand. In other words, supply must be ready for the demand and not merely strive to keep up with it.

"BATTLE OF THE SYSTEMS"

In opening the discussion on the first two of the "Electricity and Transport" papers presented at the British Electrical Power Convention last week, Sir John Hacking spoke of the "battle of the systems." Sir John approved the decision to electrify on the 25 kV 50 c/s system although he said that so far there had been only limited experience of the system. Later speakers introduced many narrower issues all of which seemed to confuse the main issue until, we thought, clarification was brought about by its being emphasised that what had been decided upon by the British Transport Commission was a combined system using a.c. track distribution and d.c. driving.

The major consideration on which the decision of the B.T.C. was based was the very high degree of economy which will be achieved by the use of a high voltage on the overhead distribution system in the way of greater spacing of substations and considerable saving in the expensive material—copper.

One speaker asserted that the battle of the systems was won. We believe that all the B.T.C. can fairly claim is that they have made up their minds and have taken a bold and wise decision which greatly clears the way for their ambitious programme.

THE DRIVING UNIT

Another point which was brought to the fore in the discussions on the B.E.P.C. "Electricity and Transport" papers was the use of the d.c. or the a.c. motor for the actual "tractive effort." Here again the railways are largely following practice giving advantages which have been reaped both in and out of the railway field for a very long time.

Despite the general application of a.c. for half a century or so the d.c. motor has been retained very largely throughout industry, particularly heavy industry, because of its incomparable capabilities in respect of variable speed driving. This has persisted even in the face of the very good performance in this direction of the modern a.c. commutator motor, particularly where induction voltage regulation is adopted.

We think, however, that perhaps speakers generally went too far in regarding the d.c. motor as the last word in driving units. We agree with all that was said about the d.c. motor being a rugged equipment—low in both capital and maintenance costs—and we must supplement such observations with our own observations of the superior behaviour of the d.c. motor in certain cases where the maximum range of infinitely variable speed has been called for. All the same there is the indisputable fact that the vast majority of motors employed throughout industry are a.c. machines. Further, we are constantly coming across the a.c. motor working under such arduous conditions that it may be considered to be as "rugged" as its d.c. brother. It is at least likely that all those working so hard on the further development of the a.c. motor will sooner or later produce a machine which will equal the d.c. motor for variable speed driving.

ELECTRICAL WHO'S WHO

The 1956–57 edition of the "Electrical Who's Who" has been considerably enlarged and contains some 7,000 entries in addition to the index in which names in the biographical section are classified under companies or other organisations. It is available from Iliffe & Sons, Ltd., Dorset House, Stamford Street, S.E.1; the price remains at 21s (postage 1s 5d)

NUCLEAR POWER

The news that the chain reaction was successfully started at the Calder Hall power station on 22nd May marks a significant moment in the history of electricity supply, not only in this country but throughout the world. Although this is not the first nuclear power station to operate it is the largest so far constructed and planned for the regular supply of electrical energy to a national network, amounting to more than 60 MW. Russia had a 5,000 kW plant in operation two years ago of the pressurised water-cooled type and the United States has supplied energy from reactors to electricity networks, but not on a permanent, planned, large-scale basis.

To this country the moment is even more important, representing as it must do the beginning of the nuclear generating era. The first nuclear power station to be commissioned by the Central Electricity Authority will also represent a major step in this direction, but this week has undoubtedly seen the real beginning.

That H.M. the Queen is to open the plant in October is a fitting recognition of the part that this pioneer installation will play in smoothing the path for the rapid and large-scale exploitation of generation by nuclear fission, so vital to our future progress in all fields.

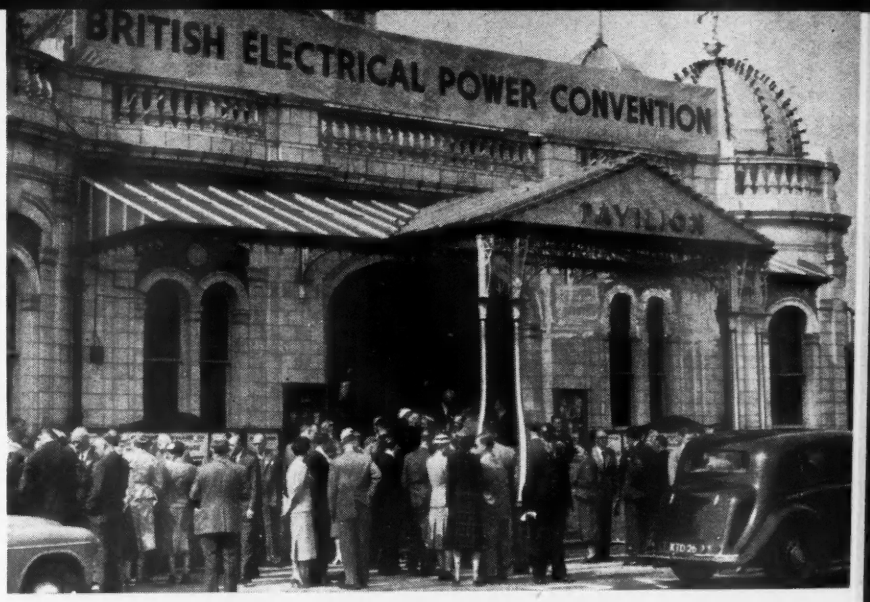
ELECTRICAL FIRE RISKS

According to the report of the Fire Research Board and the Director of Fire Research for the year 1955, which has just been published for the Department of Scientific and Industrial Research by H.M. Stationery Office, the incidence of fires due to electrical causes is still rising. Out of a total of 45,970 fires in buildings, 8,462 originated in electrical apparatus of one sort or another, and of 38,530 fires other than those in buildings 3,548 originated in electrical equipment. The incidence of electrical fires in this country during the period 1947-52 has been examined and it appears that the fires of electrical origin increase uniformly with the consumption of electricity. The number of fires due to wire and cable appeared to be independent of the electrical energy transmitted, but the fires due to electrical apparatus were directly proportional to the energy transmitted, and the rate amounted to one fire per ten million kWh.

Bearing in mind the scheduled increase in generating capacity up to 1975 it would seem that if the present trends are maintained the rate of electrical fires will be trebled in the next 20 years. Out of a total number of fires of all kinds of 84,500, electricity accounted for 14·4 per cent as the largest single cause and a large proportion of these occurred in the home. The report emphasises that amateur additions to wiring installations are one of the chief sources of danger.

B.E.P.C.

Torquay Papers and Proceedings



IN brilliant weather (which failed on the following day) the eighth British Electrical Power Convention opened at Torquay on Wednesday last week. During the afternoon arriving delegates were engaged, as usual, in re-establishing former Convention friendships and making a preliminary inspection of the exhibition in Torre Abbey Meadows. It was the unanimous opinion of the visitors that this was the finest show yet organised at a Power Convention. Exhibitors, too, appeared to be very pleased with the arrangements although the fear was expressed that the E.D.A. all-electric bungalow might tend to overshadow the individual firms' exhibits. This bungalow was certainly very attractive, especially to lady visitors many of whom made tentative enquiries about the possibility of acquiring it complete after the Convention.

The South Western Electricity Board's display "Window on Electricity" formed a very comprehensive review of domestic electrical services. The Board were hosts at a party given at the Imperial Hotel in the evening when Mr. A. N. Irens (the chairman) and Mrs. Irens received a large gathering of guests.

Sir John Dalton, M.I.E.E., F.C.I.S., the Convention President, who was accompanied by the Mayor and Mayoress of Torquay, formally opened the exhibition later in the evening. He was introduced by Mr. Denis Bellamy, chairman of the British Electrical Development Association, who said that he was acting for Mr. C. R. King, chairman of the Exhibition Committee, who was abroad on business.

Sir John, in declaring the exhibition open, thanked E.D.A. and the exhibitors for putting on such a fine show. He hoped that the exhibitors would be rewarded by the interest of delegates in what they had on view. Mr. Bellamy concluded the proceedings by making electrical presentations to Lady Dalton and the Mayoress as mementos of the occasion.

On Thursday morning the delegates assembled in full force at the Pavilion to hear the presidential address. Sir John arrived in a 60-year-old electric brougham (depicted on page 921) to the great joy of those awaiting him who gave him a vociferous welcome.

In the hall the backcloth of the platform bore a circular "B.E.P.C." design lettering which when the lights were switched off had a fluorescent glow. Then this was raised and there was revealed a representation of the Convention theme "Electricity and Transport," taking the form of pictures of an electric locomotive, with train, and a trolley-bus.

Sir John introduced the Mayor of Torquay (Councillor I. Joseph) mentioning that it was His Worship's first official function since his installation the day before. The Mayor,

Sir John Dalton, President of the Convention, opening the exhibition in Torre Abbey Meadows

in welcoming the delegates, recalled that he had met many of those present at earlier Torquay Conventions and he hoped that they would come again in the near future.

The President reported that a telegram of loyal greetings had been sent to the Queen and a reply had been received. Sir John said that he had also had a letter from the Prime Minister's office wishing the Convention success. He then proceeded to deliver his address in a masterly way.

Upon its conclusion Mr. J. R. Beard (past-president) moved a vote of thanks to Sir John. He said that the President had had experience of many sides of the industry and his legal training was apparent in the way in which he had assembled his address which was an excellent introduction to the Convention papers. It was a pity that the Weir Committee's recommendations had not been acted upon; if they had we would have been world leaders in railway electrification. He mentioned the extensive plans of the former L.N.E. Railway which were brought to a stop by the amalgamation of the railways.

Referring to Sir John's comparison of prospective railway demand with consumption for radio and television he thought that there would have to be a Convention dealing with light current applications. Mr. Beard said that the electricity supply industry was the first of the nationalised industries to recognise the importance to export trade of displaying to visitors from other countries developments carried out at home. He concluded by saying that Sir John, as a former middle-weight boxer, knew where to place his blows most effectively; he hoped that the Government would reconsider the restrictions which it had imposed.

On the Thursday afternoon Lady Dalton entertained the lady delegates to tea at Torre Abbey and the Mayor and Mayoress held a reception, followed by a dance, at the Town Hall in the evening.

Electricity and Transport

RAIL TRANSPORTATION

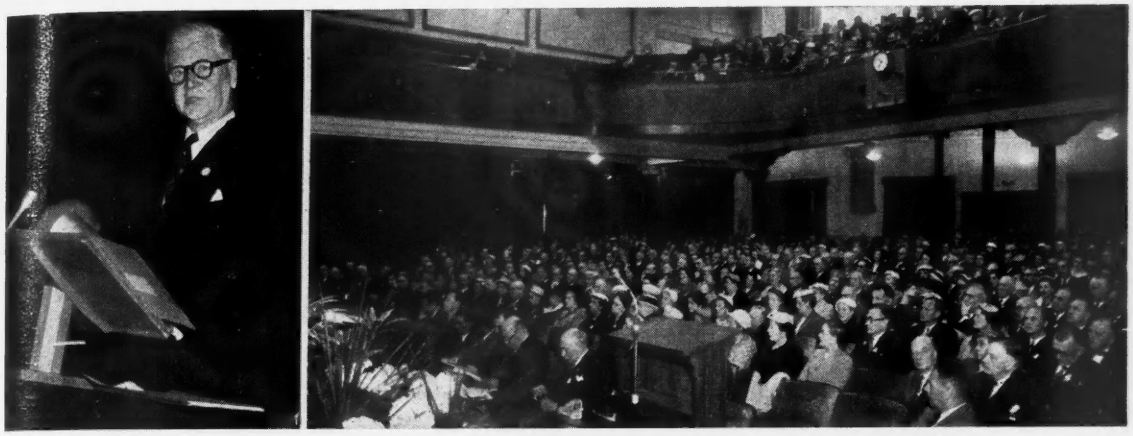
THE first technical session was held on Friday morning, the opening paper being presented by Mr. S. B. Warder, chief electrical engineer, British Transport Commission, British Railways Division. He chose electricity in rail transportation as his subject and he began by giving a brief historical review describing the manner in which a.c. and d.c. systems of railway electrification had naturally developed. He referred to the impact of various developments and described the part they played in leading to the merging of the best features of a.c. and d.c. systems into a new form of electric traction.

The main part of Mr. Warder's paper was devoted to a description of the new system of traction at the standard frequency which the British Transport Commission has decided to adopt as the standard system for the United Kingdom in preference to the 1,500 V d.c. system. He said that the case for preferring the 25 kV a.c. system was clearly established on the quality of the two systems under each of the main headings of power supply, overhead line equipment and motive power.

Financial comparisons in a specific case supported the choice both as regards first cost and running cost. It would be reasonable to forecast an ultimate prospective economy of £100 million if the economy to be derived from the adoption of the a.c. system in place of the d.c. system was achieved. This saving was based on the assumption that 75 per cent of the further economies that seemed potentially possible in the future where applied to the single track mileage on which traffic density in 1949 exceeded three million miles were realised.

In its simplest terms the 50 c/s a.c. system was an association of the best features of the a.c. system with the best features of the d.c. system, i.e., the high a.c. voltage and light fixed equipment associated with an attractive power supply from the grid, and the rugged d.c. traction motor with its special ability for heavy and light duty and variable speed operation. Thus it possessed the ideal

The opening session of the Convention: Sir John Dalton introducing the Mayor of Torquay



Sir John delivering his presidential address : the audience is seen in the right-hand picture

characteristics and put an end to speculation as to which system was the best.

As already announced it was intended to electrify as quickly as possible the London-Midland Region main line from Crewe to Manchester so that experience in proving equipment could be gained. Simultaneously, work would commence on the lines associated with Liverpool Street Station (Eastern Region) which would include the conversion of the existing 1,500 V d.c. Shenfield line in the interests of inter-running and operational flexibility.

The 50 c/s a.c. system was young and unlike the more mature 1,500 V d.c. system, should be able to look forward to considerable development and simplification. Both British Railways and the electrical manufacturing industry in this country should stand to gain from the closest collaboration in its development. The British Transport Commission had been heartened and impressed by the welcome its decision had been given by the industry generally.

Mr. S. B. Warder presenting his paper on "Electricity in Rail Transportation"

THE RAILWAY LOAD

THE next paper, "Electricity Supply and the Railway Load," was presented by Mr. F. J. Lane, deputy chief engineer (transmission), Central Electricity Authority, and Mr. W. B. Noddings, the chief commercial officer. They began by reviewing the limited progress so far made in railway electrification in Great Britain. The first considerable length of electrified railway was a stretch of about 30 miles on Tyneside and there were still only about 1,000 miles of electrified railway in Great Britain, apart from the London Underground system, and three-quarters of that total radiated south-west and south-east from London. The industrial areas of the country had been largely untouched until recently. Since the pioneer ventures 50 years ago the average rate of growth had only been 20 miles per annum, and the present position still made a poor showing in comparison with other countries.

The 50-year period had witnessed the paradox of a spectacular advance in the application of electricity to almost every other field of national life, in contrast with the slow progress in railway traction and the decline in electric street traction. The history of railway electrification had to some extent followed a course analogous to that of the development of public electricity supply. The early systems were purely local, and extension on a wider scale followed much later and somewhat sporadically. It was to be hoped that the analogy would continue to hold, to the point where there would be a complete national network of electrified railways, just as there was a complete electricity network. Some significance might at least be seen in the fact that the major railway electrification schemes were at last being embarked upon, after years of advocacy and argument, at a time when the 275 kV supergrid was well under way.

The authors brought their story up to date by referring to the Cock Report and the railway plan of 1955 and to the recent development of the 50 c/s h.v. single-phase traction system. They showed that where there was a substantial high voltage grid system the estimated capital costs of providing traction supplies at 50 c/s h.v. single-phase were less than for the hitherto adopted standard of 1,500 V d.c.

The authors referred to the technical considerations which had to be taken into account in the supply of large single-phase loads from the grid system, the main considerations being the degree of out-of-balance to be expected and the power factor of the supply taken. The degree of out-of-balance depended on the point on the system at which supplies were taken, and the lower the short-circuit level the greater the effect, the coefficient of asymmetry being approximately the ratio of single-phase load to short-circuit power. In the opinion of the French engineers the coefficient should not exceed 5 per cent. For a load of 20 MW the coefficient would therefore be 4 per cent with a short-circuit level of 500 MVA but only $1\frac{1}{3}$ per cent for a short-circuit level of 1,500 MVA, and it was therefore clear that it would be preferable to furnish such supplies from the 132 kV system rather than from the lower voltage distribution systems. Any detrimental effect of single-phase load would be far less on the 132 kV grid than on lower voltage systems; in fact there were not many parts of lower voltage systems which could accept such

large loads without considerable reinforcement. The interest of the electricity supply system in the final choice lay in the power factor and effective harmonics generated. Higher power factors would be obtained with the d.c. drive and this was therefore to be preferred. The effect of harmonics on the system was related to the coefficient of asymmetry at the point of supply and interference would be less with supplies taken direct from the 132 kV system.

The authors next discussed the effect of the development of railway electrification on the national system and showed that the additional maximum demand to be expected from the railway load was small in comparison both with the present demand on the system and with the expected general growth. On the other hand, while the diversity between the present largely suburban railway traction load and the general system load was small, main line electrification gave the prospect of a greater measure of diversity and an improvement in system load factor which would be welcome.

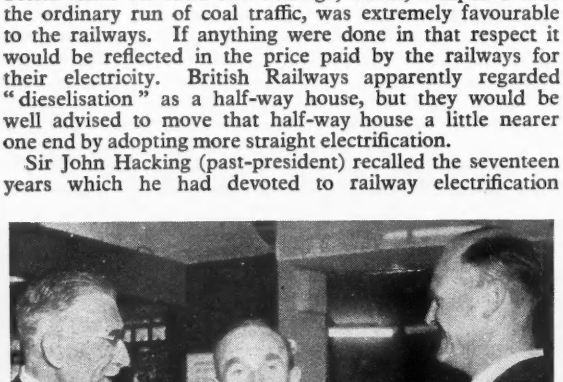
The present railway electrification programme was only a relatively small proportion of the heavy-density mileage of the British Railways system, and recent Continental experience in the high voltage single-phase a.c. field might well lead to some reassessment of the scope of railway electrification in this country.

Joint discussion on the papers "Electricity in Rail Transportation" by S. B. Warder and "Electricity Supply and the Railway Load" by F. J. Lane and W. B. Noddings.

Mr. S. B. Warder, in presenting his paper, said that when the present programme of railway electrification had been completed the organisation which had carried out the work was unlikely to be disbanded, and he would expect electrification to continue at about the same rate, which would ensure that about half the British Railways system would be electrified within 30 years.

Mr. W. B. Noddings, who presented his and Mr. Lane's paper, referred to the fact that Mr. Warder had criticised the price of electricity and pointed out that the railways had had favourable treatment in this respect since 1926, so that the cost of electricity had not been an obstacle to railway electrification. The railways should give the C.E.A. better terms for their coal haulage, which, compared with the ordinary run of coal traffic, was extremely favourable to the railways. If anything were done in that respect it would be reflected in the price paid by the railways for their electricity. British Railways apparently regarded "dieselisation" as a half-way house, but they would be well advised to move that half-way house a little nearer one end by adopting more straight electrification.

Sir John Hacking (past-president) recalled the seventeen years which he had devoted to railway electrification problems in many parts of the world and using many different systems. The availability of reliable rectifiers and the development of electricity supply had now made it possible to consider schemes which combined the advantages of both a.c. and d.c. systems. While he felt that British Railways were right in going ahead with the h.v. 50 c/s system, it must not be forgotten that there was at present only limited experience of this system and constant watchfulness would be necessary in its gradual development. The problem of avoiding bridging two separate phases with the locomotive was not easy to solve, and probably Mr. Warder was not entirely happy about the solution which had been proposed.



Messrs. J. I. Bernard, T. E. Daniel and E. B. Sawyer

Mr. H. West (B.E.A.M.A.) said that in view of the lack of experience in the home market British manufacturers had done well to enter the export market so successfully. There was no doubt that the use of the mercury-arc or semi-conductor type of rectifier in conjunction with the d.c. motor offered considerable advantages, but the present semi-conductor rectifiers were likely to be more prone to harmonic interference than the mercury-arc type. This might be obviated to some extent by fitting condensers to absorb the higher harmonics, and the problem would be relieved by the silicon rectifier. Where there was not sufficient overhead clearance for 25 kV and a lower voltage was used, it would probably be necessary to increase the contact pressure of the pantograph possibly by supplementary air pressure.

Mr. O. J. Crompton (I.E.E.) suggested that the biggest economies in overhead line equipment with the high-voltage a.c. system would be obtained on open route double track lines. With four tracks there would be a different story. On the Manchester-Sheffield line a simple portal structure carried four heavy d.c. equipments but would not be strong enough to take four light a.c. equipments with automatic tensioning, while at junctions the economy with a.c. would be very small indeed.

Mr. C. C. Inglis (chief research officer, British Transport Commission) said that in accepting Mr. Warder's recommendation for a.c. electrification the British Transport Commission had taken into account the advantages of flexibility, reliability, extensibility and capability of improvement, the value of which could not be measured in terms of money. So far as extensibility was concerned, when the main backbone of the country, the two principal routes to the north, had been electrified, it would be possible to electrify the "ribs," the branches 20 to 30 miles long, without any additional substations or cables. Traction motors and transformers rarely failed; it was the "gadgets" which gave trouble, and it was therefore desirable to use for auxiliary drives a good squirrel-cage motor rather than a small commutator machine. The 1,500 V and 3,000 V systems were more or less at the limit of their development, while the 25 kV system already gave as good a service and much the same reliability and had obviously a tremendous future.

Mr. J. Eccles (deputy chairman (operation), C.E.A.) remarked that it would be easy to paint a gloomy picture of the history of railway electrification in this country and to discuss its causes, not the least of which might be the attitude of the non-technical octogenarian management of some of the railway systems in the past. Had the Weir Committee's report been implemented within a period of, say, five years, the country would probably have saved by now 200 million tons of coal. In 1955 the C.E.A. had had to use 4 million tons of imported coal; more than twice that amount would have been saved had British Railways been able to implement the Weir report. All the countries of the world were on the move technically, and if we continued to find excuses for doing nothing we should be left behind. The supply side would place no obstacles in the way of the realisation of the railways' scheme, technical or economic, and would have full regard for the national interest.

Mr. H. L. Buckman (London Transport Executive), on the question of past history, asked why other railways had not been able to follow the example of the Southern Region. In terms of both maximum demand and annual

consumption, London Transport required about one-sixth of the demand of the London Electricity Board area. Whilst appreciating the inherent flexibility of the national supplies, other consumers might have equal priority with the railways in the event of a failure of supply, and this would be most unsatisfactory for the tube railways, with their dense services.

Mr. W. B. Noddings reading the paper by himself and Mr. F. J. Lane

Mr. C. J. Corson (B.E.A.M.A.), referring to Mr. Warder's suggestion that electrification had been stopped in the United States by the advent of mass-produced diesel-electric locomotives, showed that the density of the traffic was in general insufficient in that country to justify electrification. In dealing with the difficulty of clearance, where the normal 25 kV would be reduced to about 6·6 kV, Mr. Warder suggested that the transition from one voltage to the other might be made automatically. Mr. Corson was unable to visualise how automatic action could be devised requiring no action on the part of the driver, having in mind the need for the apparatus to "fail to safety," so that no action or inaction on the part of the driver could have worse results than becalming the train. A voltage-sensitive relay to sense a change of voltage and initiate the necessary tap-changing operation before connection of the transformer to the line would not appear to fail to safety, and in the event of the failure or maloperation of such a relay the locomotive circuit-breaker would be the only remaining line of defence.

Mr. W. K. Allen (Jersey Electricity Co.) assumed that 25 kV had been decided on in preference to 33 kV for three reasons: that the locomotives would be standard for export; that interposing transformers would be necessary in any case when coupling to the Board's system; and that the standard 33 kV insulation would be used.

Mr. F. H. Bramwell (E.R.A.) said that the railway electrification scheme would involve the whole of the heavy and a good deal of the light electrical manufacturing industry of the country, and therefore the research problems likely to arise could well be dealt with by a communal research organisation, with consequent economy in money and research personnel. The E.R.A. was moving at the end of June to its very fine new research establishment in Leatherhead. The cost, some £400,000, had been met by the generosity of the C.E.A. and of the electrical industry generally. In these new premises it would be possible to work more efficiently than in the past, but more money would be required.

Mr. S. B. Warder, replying to the discussion on his paper, from his experience on the Southern Railway supported what Mr. Buckman had said about the relative reliability of power supplies. In those days, he said, their own power supply had been more reliable than that provided by the old Central Electricity Board, but the area which they could supply was limited, and it was the Central Electricity Board which had made possible the extension of electrification beyond the confines of London.

Mr. F. J. Lane, replying to the discussion on the second paper, said that they had no desire to minimise the problems presented by a.c. supply to the railways. It was a load which occasionally might be subject to violent fluctuations; it was a single-phase load, and it would produce harmonics in the system. It demanded a cautious approach, and the taking of the supply from the 132 kV system, where the short-circuit level was high and the system impedance in effect low.

Mr. Norman Elliott (S.E. Electricity Board), in proposing a vote of thanks to the authors, said that the steam locomotive had "personality," and he hoped that the Transport Commission would see to it that the electric locomotives of the future carried on this tradition.

ELECTRICITY IN LOCOMOTIVES

ON Friday afternoon Mr. C. M. Cock, general manager of the Traction Department, English Electric Co., Ltd., gave a paper on electricity in locomotives. He said that although the steam locomotive was often taken as synonymous with railways there were in fact more than 9,800 electric locomotives in operation throughout the world to-day, in addition to about 29,000 diesel-electric locomotives and 28 gas-turbine-electric locomotives. Together these amounted to about 19 per cent of the world's locomotives.

He gave a historical survey of developments in electric locomotives and said it was becoming clear from experience in recent years that the highest practicable voltage should be used for the locomotive contact line and the retention of the d.c. series motor for driving was desirable. There was no doubt that the electric locomotive as an efficient form of motive power was superior to all others. It was capable of rapid acceleration up to the limits of adhesion and had great advantages in ascending gradients because it could draw almost unlimited power from the lines. He did not discuss in the paper the economics of electrification versus other forms of traction as this involved so much comparison of fixed equipment.

On d.c. systems the voltage was limited to a nominal 3,000 imposed largely by the locomotive equipment. The main difficulty with a.c. locomotives to-day was that of designing a satisfactory variable speed a.c. motor, and although the low frequency commutator motor had worked satisfactorily for many years it had not yet reached the standard of its d.c. counterpart. The last 20 years, however, had seen much development in locomotives supplied at the standard industrial frequency, particularly in France, and as a result of all the work which had been done he felt that there now appeared to be general agreement that the well-tried d.c. series motor fed from rectifiers was the best proposition.

Dealing with mechanical design, he said that modern electric and thermo-electric locomotives were fairly similar as far as this was concerned. Double-bogie locomotives with two or three axles per bogie and with swing bolsters had proved satisfactory up to the highest speeds and sufficiently flexible to negotiate all normal curves.

Modern electric locomotives ranged from simple two-axle types of 200 h.p. to complex units of 12,000 h.p. and weights varied from 20 to 446 tons: the h.p. per axle was now of the order of 1,000. For a.c. systems both regenerative and rheostatic braking were possible, but complicated, and the more usual method was to use the dynamic brake exactly as with d.c. systems, with the motors excited from a d.c. source.

Mr. Cock next dealt with diesel-electric locomotives and said that transmission of power from the engine was predominantly by electrical means although mechanical and hydraulic transmissions were in use, particularly for powers up to 500-600 h.p. The output from the diesel

engine shaft limited the power of the locomotive and there was no overload capacity beyond this. There were undoubtedly many overall operating economies to be obtained by the use of diesel-electric locomotives and he quoted many operators who had found that the repair and inspection of these was easier while the availability and utilisation was much better, than for steam. In addition, they were able to give better acceleration thus improving running schedules. In terms of net thermal efficiency that of the diesel-electric locomotive was about 26 per cent at the rail.

The last section of the paper dealt with gas-turbine-electric locomotives and the attractions of these were quoted as an inherent simplicity as compared with the reciprocating engine; an ability to use a cheaper fuel than distillate; and a smaller weight and bulk for a given power due to high rotational speed.

Mr. C. M. Cock, author of "Electricity in Locomotives," at the lectern

Dynamometer car trials on British Railways had indicated that the thermal efficiency of those so far tested was little better than that of steam locomotives when hauling similar loads over similar routes, and he felt that at the present stage of development the margin of overall economy was unlikely to give them any superiority over the diesel locomotive. Progress would appear to depend mainly on higher average thermal efficiencies from the gas turbine or on much cheaper fuels becoming practicable.

MULTIPLE UNIT STOCK

THE next paper, by Mr. F. A. Manley, manager of the Traction Department of the General Electric Co., Ltd., was concerned with electric multiple-unit trains and equipment. The author began by saying that to-day the multiple-unit electric train was being used by all the principal railways of the world for suburban services. Among its characteristics were high acceleration, maximum passenger capacity and ready adjustment to varying traffic demands. Lengthening a train of this type did not detract from its performance, as each unit provided its own motive power, while trains could be divided at junctions and the separated sections proceed to different destinations under their own power.

Unit compositions, and the number of vehicles per unit, varied according to traffic requirements, but the types of vehicles used were: Motor cars, with or without driving cabs; driving trailer cars, without motors, but having complete driving controls; and trailer cars, which were not fitted with either motors or control equipment.

Multiple-unit trains operating on relatively long-distance services with infrequent stops combined high acceleration with high maximum running speed. The new trains for the Liverpool Street-Southend electrification would attain a maximum of 68 m.p.h. on the average section between stops, and achieve a mean overall speed, including station stops averaging 30 sec, of 41·5 m.p.h.

The ideal method of distributing motive power throughout the train would be to motor every axle, but in practice this generally would be uneconomic and so the proportion of motored axles in practice varied between 50 per cent and 25 per cent.

Where two motors per car were used on 600-750 V d.c. systems, one motor was often mounted in each bogie. With such an arrangement the bogie centre pivot could be offset, resulting in an increase in the weight on the driven axles. Recent designs of London Transport motor cars using this arrangement had 60 per cent of the car weight on the two motored axles.

It was general in British and American practice for the motors to be mounted in the bogies with half their weight resting directly on the driven axles. With modern lightweight motors this simple arrangement had no effect on the tendency of the bogie to set up lateral oscillations. Good riding and reduction of track wear were problems of mechanical bogie design and not of motor suspension. The axle-hung motor drove through spur gears, but in the U.S.A. and Canada some use was being made of relatively low-power, high-speed motors driving through cardan shafts and right-angle gearboxes on the road wheel axles.

Standard practice to-day was to use Class "B" insulation on all traction motors, and to design windings for a peak operating temperature of 145 deg C. Further developments in insulation techniques might result in still higher operating temperatures in future, but might bring problems in the making of connections now effected by conventional soldering, and in the lubrication of bearings.

As an example of the much smaller motor made possible for a given service by present-day design, the motors for the new Euston-Watford stock of the London Midland Region would weigh 4,840 lb (including gears and gear-case) as against the 7,840 lb of the 1926 stock motors, but would operate the same service to the same schedule.

Development was taking place in shoe type collector gear to give longer life without increased wear of the conductor rail, and to permit higher speeds. Pantograph collectors for overhead systems were equipped with single or double pans according to the value of current to be collected.

Control systems for d.c. stock normally provided automatic acceleration with two full-field and one (or occasionally two) weak-field continuous running notches. Bridge transition was usual, as this avoided interrupting the motor current. Stock with a.c. motors was controlled by tap-changing on the h.v. side or l.v. side of the main transformer. When a.c. motor cars were fitted with d.c. motors fed through rectifiers, control could be by voltage variation through transformer tappings, or by a d.c. control equipment working off a constant rectifier voltage, or by a combination of the two methods. This type of equipment was in the experimental stage and no general practice had yet emerged.

Control equipment could be of the individual contactor or the camshaft types. While the latter was more complicated mechanically, it permitted considerable reduction in the number of interlocks, and also had advantages where space was restricted. Each motor car operated as a self-contained power unit and was controlled by energising the

Mr. F. A. Manley presenting "Electric Multiple Unit Trains and Equipment"

The President and Lady Dalton arriving in the 1900 vintage electric brougham

operating coils of its control equipment from the master controller in the driving cab. The operating coils were connected in parallel to control cables called " control train lines " running the entire length of the train and fed from the master controllers.

Auxiliary machines for a multiple-unit train comprised, in general, a motor-generator to provide a low-voltage d.c. supply, and air compressors for braking and other air-operated services. On line voltages up to about 1,500 V d.c. the compressor motors were fed direct from the line, but above this voltage their supply was taken from the motor-generator set.

ELECTRIC SIGNALLING SYSTEMS

THE final paper on Friday afternoon was presented by Mr. D. G. Shipp, Westinghouse Brake & Signal Co., Ltd., who dealt with electric signalling systems for road and rail transport. He began by briefly describing the manual block system of railway signalling still employed on the greater part of our railways to-day. This used electric telegraph communication between signal boxes, and relied on strict observance of rules to ensure that each train cleared a " block section " before another was admitted. Electrical interlocking between the block telegraph instruments and the signalling apparatus had been introduced as a measure of security against forgetfulness or misunderstanding on the part of the operating staff. In these installations, points and signals were usually operated manually and so required signal boxes at close intervals along the line.

Mr. D. G. Shipp, author of " Electric Signalling Systems "

The author traced the development of railway signalling to the continuously track-circuited block system of modern installations, which permitted the train to protect itself, eliminated the delays associated with block telegraph communication, and provided a degree of safety which was practically independent of the signalman's vigilance. Electrically operated points and signals reduced manual effort and permitted fewer signal boxes operating over greater distances. Ultimate safety, however, depended upon the driver's observance of signals and the action he took to control his train. Colour light signals were replacing semaphore arms to provide a compelling indication both by night and by day.

The track circuit, which played a vital part in both systems, was dealt with in some detail because of all the signalling circuits it was affected most by the adoption of a.c. in preference to d.c. electric traction. Mr. Shipp gave descriptions and illustrations of some typical items of modern electrical signalling equipment, and of the alternative forms of signal cabin control by which traffic handling had been expedited, and the task of the signalman eased. He also gave an outline of some systems of automatic train control which could provide a final safeguard against non-observance of signals in some cases.

Improved safety and economy in working justified the introduction of track-circuit block working and colour light signals as an important part of the modernisation programme. Centralised traffic control systems, not at present used in this country, would permit even wider adoption of this principle.

The author then turned to signalling for road transport and pointed out that here there was no question of " block signalling " to establish a space interval between vehicles. Most installations since 1933 had been of the vehicle-actuated type. A vehicle approaching the red signal put in a demand for right-of-way, while any vehicle approaching a green signal tended to prevent removal of its right-of-way until it had passed through the crossing. After repeated retention, a " maximum green " time facility forced transference to the waiting traffic. With this system a high degree of road safety was secured, that is, provided the travelling public obeyed the signals and understood their responsibilities.

Joint discussion on the papers " Electricity in Locomotives " by C. M. Cock, " Electric Multiple Unit Trains and Equipment " by F. A. Manley, and " Electric Signalling Systems " by D. G. Shipp.

Mr. R. C. Bond (chief mechanical engineer, British Transport Commission), opening the discussion, pointed out that British Railways already had over 500 thermo-electric shunting locomotives, a number of diesel locomotives and several electric locomotives; in addition, 174 main line diesel-electric locomotives were on order and about 1,100 electric locomotives were planned for and now being designed, while in addition there were thousands of electric motored vehicles.

In present and future conditions they had to go in for both dieselisation and electrification. The emphasis would probably be increasingly on electrification. The plan so far promulgated was only a beginning, and there was no intention to stop at the end of 15 years. They had taken considerable steps to train staff.

On the question of axle loading, Mr. Bond said that whereas with the steam locomotive there was a small-diameter lightly-loaded wheel leading, that was not so with Bo-Bo or Co-Co diesel and electric machines, so that the civil engineering restrictions might be greater than before. One would like to feel that the axle-hung motor would be favourably regarded, but civil engineers were becoming very sensitive to unsprung weight, and the price to be paid for reasonable axle loads of 18-20 tons might be the fully-

suspended motor. British Railways were paying attention to the appearance of their electric locomotives and were determined that they should have a pleasant outline, and some of them would be named.

Mr. F. Whyman (B.E.A.M.A.) pointed out that one of the main advantages of the adoption of single-phase industrial-frequency a.c. was that many routes for which 1,500 V d.c. electrification would be completely uneconomic could now be electrified at little expense; these were routes on which diesels would normally have been used. It followed that the sphere of diesel-electric traction in this country was likely to be very much curtailed, though it should have a tremendous future in parts of the world where electric traction was not economical. The expected improvement in the full- and part-load efficiencies of the gas turbine locomotive had not materialised.

Mr. C. C. Inglis (chief research officer, British Transport Commission) said that to heat an electric train might require 10-20 per cent of the power required to draw it. It was sometimes said that the unsprung weight of the steam locomotive was greater than that of the electric locomotive, but while the former had only one axle the electric locomotive had four or six, and this might be enough to put the operating point into the "mortality" region of the fatigue curve instead of into the flat part. He wondered whether with an electric locomotive it would be too fantastic to consider having the field coils of the motor fed from one winding and the armature from another, by that means producing compound or even shunt characteristics in the motor and getting a locomotive with characteristics "tailored" to the starting condition which would automatically change to those more suitable for the running condition. Why should not liquid cooling be employed in the electric locomotive?

Referring to the high standards expected of signalling apparatus, he mentioned that a contact on a signalling relay at the present time had a failure rate of only one in 4,000 million operations.

Mr. J. H. Cansdale (B.E.A.M.A.) referred to the use of diesel-electric locomotives in the industrial field, where the demand was for small units of 150-300 h.p. The ease of control and flexibility of electric drive made it more popular in spite of its slightly higher cost. Larger units of up to 400 h.p. were successfully used for steelworks duty.

Regenerative braking had always been a cherished ideal in electric traction, but such schemes had almost without exception failed in practice because of the complications involved. Rheostatic braking was simpler and had been used with success. On the Toronto Subway it was intended to use the energy dissipated to heat the cars in the winter.

Mr. C. J. Corson (B.E.A.M.A.) agreed that there was no future for regenerative braking on electrified lines in this country. The Toronto Subway cars had every axle motored and a normal rate of acceleration exceeding 2 m.p.h./sec was achieved starting on an adverse grade of 1 in 90. So far as adhesion was concerned these results could have been achieved with only half the axles motored, but the arrangement adopted enabled small, light and cheap high-speed motors to be used.

Mr. J. H. Fraser (British Transport Commission) said that a complete revolution had been made in signal engineering in this country in the last 25 years by using an electrical instead of a mechanical agency; this had made it possible to extend very greatly the territory which one man could supervise. By the use of automatic train control the time should come when railway traffic would continue almost normally under fog conditions.

Mr. T. H. Cook (B.E.A.M.A.) questioned the wisdom of the proposed great reduction in the weight of the overhead line and its associated features. At high speeds the pantograph would leave the wire or push it away, particularly where there were abrupt variations in the height of the wire. Tests on the Valenciennes-Thionville line had shown that at speeds above 80 m.p.h. the pantograph left the wire. That would cause heavy wire and pantograph wear and interference with television and radio reception.

All three authors briefly replied, and Mr. P. V. Hunter, in proposing a vote of thanks to them, recalled that the Shildon-Newport mineral railway on the old N.E.R., for which he had designed the h.v. rotary convertor substations, had been electrified before the first world war to demonstrate to the directors that electric locomotives could fulfil all the claims made for them. In fact four electric locomotives did the work which previously required 24 steam locomotives, and accordingly it had been decided to electrify the line from York to Newcastle and but for the war this would have been done and would no doubt have led to many other schemes.

COMMONWEALTH RAILWAYS

ON the Saturday morning the first paper presented was on "Electrification of Railways in the Commonwealth," by Messrs. E. L. E. Wheatcroft and H. H. C. Barton, both of Messrs. Merz & McLellan. About 1,700 route miles of the Commonwealth railways were so far equipped for electric traction, stated the authors in introducing their paper, and with few exceptions the main line sections of these, amounting to about 1,000 route miles, grew from suburban projects serving large cities.

In a section dealing with the historical aspects of Commonwealth railway electrification the state that this had reached in the various countries was described in some detail. The first overseas country of the Commonwealth to adopt electric traction was Canada but a number of the earliest electric railways had now been abandoned and with the exception of the Toronto Subway there was very little left of interest. Another old project was that of the Victorian Government Railways in Australia. This opened in 1919 to serve Greater Melbourne and was now being

Messrs. A. J. Nicholas, N. Care and N. G. H. Thomas

Mr. and Mrs. Raymond Berry and Mr. and Mrs. A. E. Page

extended. At Calcutta an extensive programme of suburban electrification was being prepared involving about 1,000 track miles.

Virtually all the Commonwealth electric railways were equipped with overhead conductors for a d.c. system at between 1,500 and 3,000 V largely because at the time they were installed they were mainly for suburban areas and there was little doubt that the d.c. system for such duties was the most suitable. The authors felt that no new railway electrification was likely in the Commonwealth using the low frequency a.c. system but that future decisions would lie between h.v. standard frequency a.c. for new projects, and d.c. for extensions to the existing lines.

The next section of the paper dealt with technical matters in connection with substations and power supply to the stock, mainly condensed from a paper which the authors presented early in February to the Institution of Electrical Engineers and which was summarised in the *Electrical Review* of 10th February, 1956. In their view many factors pointed to rectifier rolling stock as providing the best all round method with the use of standard frequencies. The choice was between the three types: a.c. motored, motor generator type with d.c. motors or a.c. induction motors, and rectifier type with d.c. motors.

In considering the economic effects of the abandonment of steam motive power the authors thought that this could sometimes be justified by the increased track capacity obtained from diesels or electrification, enabling track doubling works to be postponed. Railway electrification in combination with suitable signalling would provide the maximum possible track capacity and in no case known to them had railway operating departments been disappointed with the services which electrification provided. Experience in many areas had shown that not only did the number of passenger journeys increase after electrification but also the average mileage travelled per passenger.

In considering future trends in the various countries of the Commonwealth they pointed out that Australia relied on coal resources to supply power for railway transport. Canada depended mainly on oil and it was therefore unlikely that in that country main line electrification could be justified in preference to diesel traction. India was also a coal producing country and main line electrification was more likely than diesels to replace steam traction.

DISCUSSION

Mr. H. H. C. Barton, who presented the paper, said that since it was written some information about the Sydney suburban electrification had been received which showed that between 1927 and 1955 the annual car mileage had increased from 10 million to 69 million, with only a 10 per cent increase in the rolling stock. That reflected great credit on the British manufacturers of the equipment and the Australian maintenance staff.

Mr. A. E. Grimsdale (B.E.A.M.A.), in opening the discussion, said that the 40 electric locomotives to which the authors referred as being built in New South Wales for the Lithgow extension were in fact being built in this country, and some had already been despatched. The braking on these locomotives was air and regenerative, the regenerative side being important because it was planned to haul trains of 2,000 tons trailing load on the heavy grades of the Blue Mountains with three locomotives coupled together controlled by one crew. The regenerative current from those three locomotives would be of the order of 2,500 A. For a distance of 20 miles there was a ruling gradient of 1 in 30.

While the advantages of supplying standard frequency a.c. direct to the locomotive were considerable, he did not agree with the authors that h.v. standard frequency a.c. was likely to be used for all new projects; there were other factors of importance to be considered. The G.I.P. line

Mr. J. R. Beard, Sir John Hacking, Mrs. Beard and Mr. W. J. Bache

through the Western Ghats in India, the Natal section of the South African Railways and the line across the Blue Mountains in New South Wales all carried heavy traffic through mountainous country, and if such projects were being considered afresh to-day he believed that the decision would be to use d.c. because of the outstanding advantage of being able to use the regenerative brake for handling heavy trains in complete safety at relatively high speeds. The advantage of improved adhesion claimed for a.c. locomotives could be nullified in hilly country, because if required to work at relatively high speeds it would be necessary to increase the weight of the traction motors and transformers, which with the limitations of loading would make it necessary in many instances to give the a.c. locomotive the same number of axles as with d.c.

Exports of electric traction equipment by British manufacturers far exceeded those of similar equipment by all the other countries of the world. Apart from Canada, railway electrification had been first introduced in all the Commonwealth countries by British manufacturers, who had also provided equipment which was in operation in seventeen other countries.

Mr. J. Boul (English Electric) said that tests on the Lancaster-Heysham line showed that the measured values of a.c. harmonic current were considerably lower than might be expected on theoretical grounds; in fact, the disparity had been so great as to lead to a re-examination of the basis of the theoretical treatment, which had shown that the simplifying assumptions acceptable for multi-phase rectifier calculations could lead to appreciable errors in the calculation of harmonic currents for single-phase rectifiers.

While they felt that they could now calculate fairly accurately the harmonic currents drawn by a single locomotive of this type, they could only determine from practical experience the overall effect of a number of locomotives operating on a given system; there was the question of the phase angle of the different harmonics and its influence in the additive sense, which would vary from day to day and from one system to another.

Sir John Hacking, while agreeing that due credit must be given to British manufacturers of electrical traction equipment, suggested that sight should not be lost of the initiative taken by the railways concerned, without which the manufacturers would not have had the opportunity to supply the equipment. That initiative had often been due to advice received from other people—not always manufacturers.

Mr. Wheatcroft, replying to the discussion, said that while the use of a.c. or d.c. had to be considered in each case on its merits, he was growing more optimistic about a.c. as time and discussion went on. There were, however, instances where the use of regenerative braking might seem to be important. For a.c. he thought that the rectifier locomotive was the right solution, and in this respect British manufacturers might have a lead over others. British manufacturers must ensure, therefore, that rectifier development went ahead quickly. The British Transport Commission was giving the manufacturers a very good opportunity to develop their 50 c/s equipment, and it was to be hoped that,

Messrs. H. H. C. Barton, E. L. E. Wheatcroft, G. S. Causon and F. G. Stevens

in spite of the different topographical conditions and the often more difficult problem of power supply in the less developed countries, this development would also be very useful in the export business.

SUBSTATION EQUIPMENT

THE second paper to be read on the Saturday morning was by Messrs. G. S. Causon and F. G. Stevens of the Hackbridge & Hewittic Electric Co., Ltd., on the subject of "Substation Equipment for Rail and Road Systems." The authors began by an historical introduction to the subject, saying that since the beginning of electrical transport it had been recognised that a d.c. drive was best for both road and rail traction. It had therefore been necessary to provide d.c. supplies to the track. Frequent supply points were required to maintain track potentials and the earlier rotating plant used for generation or conversion was expensive in attendance. The mercury arc rectifier development followed so closely on that of automatic remote controlled rotary stations that the latter never became popular and, in addition, the mercury arc rectifier had the advantage of low no-load losses.

They went on to consider substation arrangements. Rectifier transformers were always situated close to the rectifiers to reduce the length of the anode leads: the possibility of fitting on-load tap-changing gear had been considered but the greatest variation in volts reaching the vehicle was due to the traction load itself which varied too quickly for on-load tap-changing gear to follow.

Almost all traction rectifier schemes carried out in this country since the war had used either glass bulbs or pumpless steel tanks, the latter representing a compromise between the glass bulb and the larger and more complicated water cooled continuously evacuated steel tank. Grid control could be fitted to traction rectifiers to improve regulation but the improvement obtainable was generally considered not worth the extra equipment involved although simple grid control was sometimes fitted for arc suppression.

In discussing the overload capacity of rectifier equipments the authors expressed the preference for those constructed in accordance with Class III of B.S. 1698:1950 which gave the practical effect that for transformers of the same size as the Class II specification the real continuous capacity of the whole equipment was increased by about 30 per cent.

A minor disadvantage of simple rectifier equipments was that they were not capable of passing regenerated power from the d.c. to the a.c. side and this led to complications when the vehicles were capable of regenerative braking. Three solutions were possible, namely: motor generator sets, invertors and load resistances. The no-load losses of motor generator equipments were so high that they were not worth installing for the purpose. Invertors were not as inherently reliable as standard rectifiers and their installation costs were also very high relative to the energy fed back. Concentration tended to be on interconnection between substations and the provision of load resistors at a few selected points. There had, however, been a tendency in the design of vehicles recently to avoid regenerative braking altogether.

A recent development was the construction of underground rectifier substations in which the tendency was to utilise an air-cooled transformer underneath with a rectifier unit on top. Forced cooling had to be used.

DISCUSSION

Mr. G. S. Causon, in presenting the paper, said that in the last few years much more consideration had been given to the effect of the harmonic current drawn from the a.c. supply systems, particularly as the proportion of rectifier plant over other equipment had become much greater. The authors understood that suggestions had been drawn up by the C.E.A. Engineering Department to indicate the manner in which the required number of phases of any rectifier equipment could be simply determined by taking the short-circuit capacity of the system as a measure of the impedance of the network feeding the rectifier and relating this to the anticipated peak demand of the rectifier plant installed, the recommended number of phases being found from appropriate curves. While such a method was of interest, such curves might create apprehension when more than twelve phases were indicated. In the authors' opinion for most traction systems drawing their supply from substations fed from systems of 33 kV or less, twelve phases were sufficient. Only in exceptional cases where heavy power supplies were required was multiplication up to 24 phases necessary, and in no case could more than this be justified.

Trolley-buses and tramway systems were falling out of favour in this country, although overseas they seemed to be gaining in popularity. He imagined that urban and suburban road transport would ultimately make use of some form of electric power, drawing supplies from atomic power stations. Electric traction for road vehicles might be losing ground in this country because it was too costly, and perhaps too elaborate in its substation and overhead equipment. On the Continent the simplicity of the substations, the lack of elaborate switchgear and the simple means adopted to control the rectifier equipments were striking, and the overhead equipment seemed far less heavy and of simpler design. Simplification of equipment would reduce the cost.

Mr. E. Gallizia (B.E.A.M.A.), opening the discussion, supported the authors' plea for simplicity. With the steel tank rectifier, he said, there was normally no need for anode fuses; the plant could carry on until it tripped itself out

and be switched at the appropriate moment. Many steel tank pumpless rectifiers installed in the 1930s had been operating for more than 20 years without attention and there was no evidence that they were getting towards the end of their life. The development of crystal rectifiers of the germanium or silicon type was very important, but with the work in hand to make the mercury arc rectifier more compact and to reduce its losses, it should have a very big future not only in static substations but on locomotives.

Mr. H. L. Buckman (London Transport Executive) referred to some of the information gained by London Transport in rebuilding substations which had been operating for many years. With the heavy duty imposed on d.c. switchgear it required greatly increased space in railway substations, but the problem could be met by mounting the rectifiers immediately over the transformers. There was need for some means of cheaply and reliably showing to a remote operator what the load was on a rectifier, so that he could switch another on if necessary.

London Transport were experimenting with the integrating type of tripping relay to which the authors referred. It showed promise, but its calibration was tricky and peculiar to each case. They were using a type of rectifier unit built up as an assembly of sub-units, and the portability thus obtained had proved of great value in their work of modernisation. The 25 kV a.c. system would virtually have the effect of locating the substation on the train, and this presented problems for which a solution must be found.

Mr. J. Boul, while agreeing that simplicity was the keynote of good engineering, expressed surprise that a plea should be made for greater simplicity in transport systems in this country. On the Continent there was a degree of complexity never found here. British Railways and the L.T.E. gave every encouragement to British manufacturers to simplify, and he did not think that it would be possible to go further than was being done on current contracts.

Commenting on the authors' statement that it was usual to earth the running rails so that they could not rise to a dangerous potential, he referred to some 1,500 V and 3,000 V systems in which the running rail was not continuously earthed but a relay was provided which earthed it when the potential to earth reached a certain value. This met the conflicting requirements of avoiding electrolytic corrosion of pipelines and protecting stray animals.

Mr. E. E. Hutchings (E.R.A.) referred to the work which the E.R.A. had done in collaboration with railways at home and abroad and with the Post Office and manufacturers and others in solving some of the problems to which the authors referred, such as the generation of harmonics by rectifiers and interference with nearby communication circuits.

Mr. F. G. Stevens, in reply, said that regeneration might seem a good idea when there was a large coal train going down a long hill; it saved brake wear and put energy back into the contact wire and so to some other train. But for passenger trains with frequent starts and stops it could lead to a good deal of trouble. In order to get a rate of deceleration comparable to that obtained with air brakes it was necessary to pump back about 6,000 kW from an eight-coach train. That might be taken as 10,000 A at 600 V, but 10,000 A took about 300 V to send a mile down the track, so that big problems were involved.

There was a tendency in this country to feel that a good, robust job had been done when many miles of copper had been put in, but it was notable that on the Continent substations were put in close to where the power was wanted, with almost no d.c. feeders.

The Domestic Consumer

IN presenting his paper bearing this title Mr. D. Bellamy said that the real economics of the issue under the present conditions of higher costs of production and supply and the general level of domestic tariffs were continuously controversial and the many criticisms expressed or implied could be classified under four main headings, viz. (*a*) from comparisons of the average prices now paid with those ruling in 1938 it could be concluded that industry was subsidising the domestic consumer; (*b*) the conversion of coal into electricity for the provision of heat services in the home was wasteful of the country's fuel resources; (*c*) the electricity supply industry could not afford to supply and distribute electricity at a price which would make it competitive with other fuels in the home; and (*d*) an appreciation of the real economic value to the domestic consumer of the present competitive price levels appeared to be lacking. Mr. Bellamy then went on to discuss the facts relating to these criticisms.

Comparing the average prices charged to different classes of consumer he said that while the domestic price which (within the accuracy of statistics) was the same in 1937-38 as in 1954-55, the industrial price showed an increase of 78 per cent. Without qualification this comparison was liable to be accepted by the uninitiated as showing unfavourable treatment of the industrial consumer. Domestic tariffs had, however, been increased substantially, but this increase had been concealed in the statistics of average prices by the greater consumption per consumer.

Examination of the prices charged to domestic consumers revealed that in 1938 the average consumption was 600 kWh per annum, whereas by 1955 this had increased to 1,400 kWh. Based upon the 1938 tariff this would have

Left: Mr. A. N. Irens and Mrs. Irens (right) receiving Sir John and Lady Dalton at the South Western Electricity Board's reception. Right: Mr. and Mrs. H. D. B. Wood and Mr. and Mrs. E. G. Plucknett

1. Back row: Messrs. A. H. Olson, J. G. Briggs, R. A. Marryat and J. Smellie; front row: Mrs. Smellie, Mrs. Marryat, Mrs. Briggs and Mrs. Olson. 2. Mr. E. C. Norfolk with Dr. and Mrs. Ballin. 3. Mr. and Mrs. S. F. Steward. 4. An E.A.W. group: (standing) Miss F. M. Pugh, Mrs. L. B. Humphries, Miss M. E. Bailey, Miss A. S. Lockhart and Miss P. Thompson; (seated) Miss V. Norvick, Miss N. Balls and Mrs. N. G. Wallace

given an average price of 0·938d/kWh but the actual average in 1954-55 was in fact 1·518d. The effective increase of the 1955 tariff over that for 1938 was, therefore, 62 per cent, which was a broad general average for the country as a whole. If the prices for industrial supplies were examined it was seen that there were many more variations in the greater number of industrial tariffs operating before standardisation. A reasonable approximation to an average industrial demand tariff for 1955 was £5 5s/kVA per annum and 0·7d/kWh (with coal at £3 per ton) compared with £4 10s/kVA per annum and 0·3d/kWh (with coal at £1 per ton) in 1938. Effective increase over the 1938 tariff was, therefore, 64 per cent. Thus the effective increase in the domestic tariff since before the war was only slightly less than the corresponding effective increase in the industrial tariff.

Dealing with the subject of fuel utilisation Mr. Bellamy said that during 1954 38 million tons of coal was used in electricity works and of this some 24 million tons was uncleaned slacks and smalls, the proportion of which was increasing at a significant rate. Figures adopted in the Ridley Report indicated that in spite of the much lower grade of fuel, electricity provided heat at the point of utilisation with an efficiency approaching that of other fuels.

On the question of the economics of domestic supply he said the most important factor in the determination of equitable tariffs for the separate consumer classes was the proper allocation of fixed costs to each class and this was dependent primarily on the determination of the contribution of each class to the system peak. In view of the rising cost of plant and the fact that in recent years the proportion of new plant had been increasing it might be expected that the relationship between fixed and running costs would tend to return to the pre-war position. However, in view of the continued increase in the price of coal there was no marked tendency in this direction at present.

Reverting to the topic of predominance of capital charges, Mr. Bellamy called attention to the effect of load factor on costs. An increase of almost ten points of load factor was required to avoid a rise in average cost per kWh as a result of the increase in capital charges. In this connection a significant aspect was that retail prices during the period 1950-54 increased by about 25 per cent, whereas electricity prices increased by 16 per cent. It was clear that conditions favoured the use of electricity and extended use was even more satisfactory. Accepting that the domestic consumer must receive a supply in the first place for essential lighting and other services, it therefore followed that efforts must be made to ensure that electricity was used for more than these basic services to improve load factor.

Dealing with space heating, Mr. Bellamy said that according to the 1952 Social Survey about three-quarters of the families in this country lived in one room of the house (except for occasional periods) and in about 98 per cent of households the main appliance was a solid fuel fire or a stove. Only 32 per cent of all households possessed any form of bedroom heating and only 22 per cent bathroom heating. The position of post-war local authority houses was, however, slightly better. A solid

fuel cooker existed in about one-fifth of households but gas or electricity were the main cooking agents. It would appear that the ratio of gas to electric cookers was now just over 2½: 1, the proportion of houses with electric cookers having doubled in the past three years.

Dealing then with the all-electric house itself, the author said that the first requirement was an adequate installation of socket outlets in addition to the lighting, cooking and water heating circuits. The use of 13 A fuse plugs in conjunction with either "room circuits" or "ring circuits" was the desirable method of providing the necessary socket outlets. Apart from savings in cost, the use of fused plugs resulted in a standard plug for all appliances and dispensed with the unsafe practice of connecting small appliances to 15 A plugs by means of unfused adaptors. Home lighting should be both useful and decorative. Fluorescent lighting in any room other than the kitchen was still a rarity. Few of the general public realised that the de-luxe warm-white type of lamp closely reproduced the colour of ordinary filament lamps and for some the initial cost was a deterrent.

So far the fundamental and additional advantages of electric cooking—cleanliness, controllability and economy—had not resulted in the increase in the cooking load which was merited. Recent developments, however, had added greatly to the advantage of electric cooking. Although the price of cookers had risen in the last few years so had their facilities. If the additional facilities were discounted the selling price had risen only 3½ per cent in the face of a 50 per cent rise in cost of materials and labour.

After dealing with the various aspects of floor heating, the heat pump, water heating, laundry appliances, etc., Mr. Bellamy concluded that the domestic use of electricity, particularly in the realms of cooking and water heating, could only be extended if the consumer was able to procure the appliances. Few domestic consumers possessed the necessary cash for this equipment and hire-purchase schemes, or some equivalent, were essential. The principle of buying a house on what was essentially a hire-purchase scheme was readily accepted by most people and it was logical that the capital necessary to provide essential household equipment should be made available in a similar manner.

DISCUSSION

MR. T. E. DANIEL (chairman, N.W. Board), who opened the discussion, said the industrial consumer was still getting his electricity cheaper than the domestic consumer. The industrial load factor was tending to fall, and might go down still further with shorter working hours, while the domestic load factor was going up. The more it increased, the cheaper would be the cost of supply; an increased domestic load factor together with the increased thermal efficiency of generating stations should enable the price of electricity to be maintained at a reasonable level.

Mr. S. F. Steward (B.E.A.M.A.) emphasised that the full development of the domestic load was essential not only to the country but to the electrical industry. There was a danger that, although the domestic load would go on growing whatever was done, without a really good sales and publicity programme its development would be patchy, uneconomic and unplanned. He pleaded for a consistent and forceful selling policy.

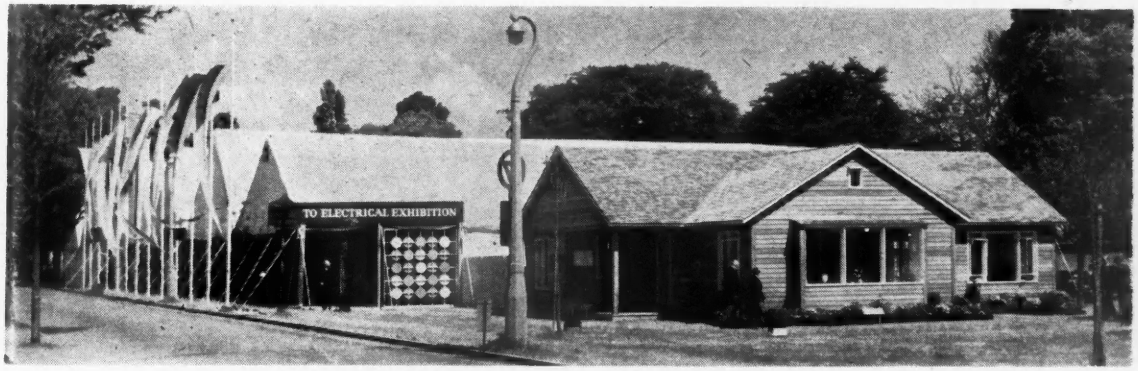
Mr. W. Moody (Yorkshire E.B.) mentioned the recommendation in the Ridley Report that to secure more efficient use of coal the time had come for the National Coal Board to negotiate with the miners new agreements which would provide adequate cash compensation for a reduced supply of concessionary coal. Mr. Moody felt that the Coal Board should give miners who had been entitled to concessionary coal chits which they could hand to the Electricity Board and so obtain a supply of electricity to replace the coal.

Mr. D. Bellamy presenting his paper.

Miss N. Balls (E.A.W.) said that this year the E.A.W. were concentrating their energies on lighting in the home and had been able to interest large numbers of new consumers, especially in rural areas, in the subject. In this they had received great assistance from E.L.M.A. Next year their campaign was to be on "Electricity for Everywoman" and they would need the help of every section of the industry.

Mr. P. G. Wallis (Electrical Contractors' Association) stressed the urgent need for a nation-wide system of installation inspection and expressed the hope that everyone in the industry would give all possible support to the National Inspection Council which was about to be inaugurated, the primary object of which would be to protect the consumer against faulty, unsafe or otherwise defective installations and appliances.

Mr. J. Gogan (S. of Scotland E.B.) said that a great amount of work had been done in the South of Scotland to develop off-peak space heating for domestic as well as for commercial and industrial premises. Great progress had been made in the continuous heating of domestic premises by means of electrode boilers, and about 40,000 kW. of load had been



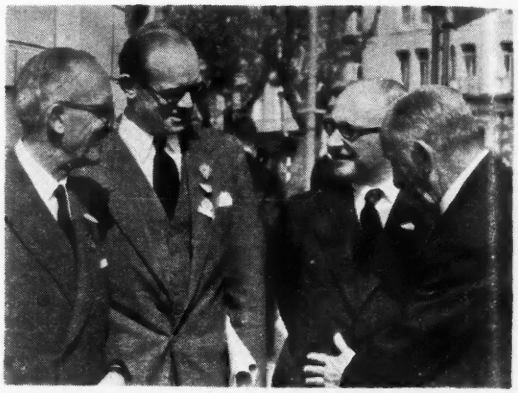
The E.D.A. all-electric bungalow with the Exhibition at the rear.

connected of such boilers alone, which was about 50 per cent. more than the load which would be obtained from railway electrification in Scotland. He agreed with Mr. Bellamy that the block storage heater would provide suitable off-peak heating in existing houses, and efforts should be made to produce this type of heater purchase-tax free for domestic use. With the development of atomic power stations, off-peak heating might be the best means of securing a worthwhile improvement in the load factor.

Mr. R. F. Richardson (C.E.A.) suggested that there was a tendency to concentrate attention on the 250,000 new houses which were being built each year and to neglect the 13 million consumers in older houses, many of whom had inadequate installations. In many houses large quantities of hot water for baths were required only once a week. In these circumstances consideration might be given to providing "tailor-made" water heaters, with the prospect of an additional 1,000 to 2,000 kWh. per annum for households of this kind.

Mr. W. K. Allen (Jersey Electricity Co.) said that after the end of the war it had been difficult in Jersey to get generating plant and import controls had been put on electrical apparatus above a certain loading. The result was that tariffs had continually to be raised to balance the accounts, and the profits of his company became too low and the price of electricity far too high. He then decided that it was necessary to reduce tariffs and encourage cooking and space-heating by every possible means. The result was that in 1955 sales of electrical apparatus averaged £11 per consumer, though there was no purchase tax; in 1955 output was 58 per cent. above that in 1950, and the index of profits in 1955 was 324, taking 1950 as 100.

Mr. A. C. Hazel (B.E.A.M.A.) deprecated the use of fire-back boilers and said that their abolition should make possible the introduction of electric water heaters. After



Sir Vincent de Ferranti, with Messrs. I. T. Morrow, M. Tattersfield and H. E. Midgley.

referring to the use of block storage heaters in Sweden, the speaker said it was a great pity that there were not more heating engineers, as distinct from electrical engineers, associated with the electrical industry. The greatest competitor of electricity in the space-heating field today was the paraffin stove.

Mr. E. E. Hutchings (E.R.A.) said that in space-heating full use must be made of the thermal capacity of the structure and all waste of heat eliminated as far as possible. There must be the closest collaboration between the architect and the electrical consultant. The E.R.A. had been able to make a direct comparison of simultaneous performance under comparable conditions of a heat pump for space-

1—Messrs. S. H. Ball, E. J. Turner, R. S. Atkinson and J. Eccles. 2—Mr. H. N. Colley with flag sellers; also 3—Messrs. B. Farnworth and J. G. Bentley. 4—Messrs. C. G. Richards, E. S. Booth, F. Favell and G. F. Davies. 5—Messrs. W. E. Wilson and R. Lonsdale. 6—Mr. and Mrs. J. E. N. Davis. 7—Councillor F. Kenyon, Miss N. Kenyon and Mr. F. J. Marron.

heating and a gas-fired boiler, and figures obtained over a period of four years would shortly be published.

Mr. B. Z. de Ferranti (B.E.A.M.A.) referred to what was said in the paper about the attempt to combine domestic water heating with larder cooling by means of the heat pump and about the tendency in the winter to over-cool the larder and have too low an output of hot water. This could be cured by fitting an immersion heater half-way up the storage tank associated with the machine.

Dr. H. H. Ballin (B.E.A.M.A.) said that people in this country were particularly sensitive to the colour of light, and manufacturers had spent years in devising a fluorescent lamp of similar colour to that of the tungsten lamp, only to find that, when they succeeded, the colour of the tungsten lamp was not wholly satisfactory; now they had produced a tungsten lamp which approximated to the colour of the fluorescent tube. There had been a lack of interest on the part of decorators and lighting engineers in domestic lighting, but welcome signs of improvement were noticeable in this respect.

Mr. W. J. Bennett (Eastern C.C.) said that the Consultative Councils were apprehensive about future trends in tariffs. A Government official had told him that electricity was being sold too cheaply and that what was wanted was a "coal parity price" giving equal opportunities to the three fuel industries. Mr. Bennett regarded this as iniquitous; the aim should be a cheap and abundant supply of electricity.

The author briefly replied.

Electric Passenger Vehicles

ON Monday afternoon Mr. J. H. Cansdale, deputy manager, Contracts, Transmission Department, British Thomson-Houston Co., Ltd., presented a paper on passenger electric road vehicles. This was concerned largely with setting out the case for the tram and the trolley bus in general terms relative to the growing congestion of our large cities. In Great Britain tramcars reached a peak in 1927 when there was a total in service of 14,700. To-day there were only about 2,000 cars operating in four cities in England and four in Scotland and Mr. Cansdale included a striking table indicating how London was one of the very few great cities in the world to have abolished trams altogether. Trolley-buses in Great Britain numbered nearly 4,000 in thirty different undertakings including 1,764 in London, where it was intended to replace them with diesel buses in the next few years.

In comparing the three types of vehicle generally available he stressed that they were not alternatives; each had advantages in its own particular sphere. Tramcars were best suited to heavy traffic requiring twenty or more cars per hour at rush periods, and a single track could move up to 13,500 passengers an hour in one direction. Trolley-buses were ideal for surface traffic requiring between six and thirty vehicles an hour on well-established routes and the motor-bus had a particular advantage for light suburban traffic and country feeder services. He felt it was strange indeed that only in Great Britain was there a lack of appreciation of the advantages of electric traction for road passenger vehicles.

The modern electric trolley-bus had a greater power available than the normal diesel-bus and this had enabled higher capacity vehicles to be made. Large numbers of three-axle trolley-buses were in service. He felt that for speed of loading and unloading the single-deck vehicle had many advantages.

Mention was made of the gyrobus, the only entirely new form of electric road vehicle to emerge in recent years. This differed from the tram and the trolley-bus in that it could operate for only a limited period and was able to travel only for a distance of about five miles on the level, between charging points. While there would doubtless be special places where it could be used with advantage, in its present form it seemed unlikely to compete seriously with the tram or the trolley-bus.

Mr. Cansdale compared the costs of running electric vehicles as against the oil-using bus and said that the cost of fuel oil had increased about two and a half times since 1939 and now represented about 20 per cent. of the operating cost of a motor-bus. On the other hand, the average cost of electric power used for traction had over the same period only increased by about 60 per cent. and now represented only 10 per cent. of the operating cost of a trolley-bus.

A modern tramcar represented a traction load of up to 100 kW and a trolley-bus of about 50 kW and in a year a trolley-bus used about 150,000 kWh. The traction load started up well before the industrial load came on and continued after industry shut down: this improved the load factor. He felt that when electric vehicles were threatened with a change-over to diesel power, full

Mr. and Mrs. P. V. Hunter with Col. and Mrs. B. H. Leeson.

The President with Messrs. R. H. Gummer and W. S. Burge.

At the Mayor's Reception : The Deputy Mayor and Mayoress, the Mayor and Mayoress, the President and Lady Dalton and Mrs. Rimmer.

Mr. O. M. Robson, Mr. J. Eccles, Mrs. Robson, Mrs. Eccles, Mrs. G. A. S. Nairn and Mr. and Mrs. A. G. F. Farquhar.

support for electric traction should be forthcoming from the local supply authority.

The traction motor as developed to-day would, with an occasional changing of brushes, last out the life of the vehicle and the remainder of the electrical equipment on a tram or trolley-bus was inherently simple and easy to maintain. Maintenance costs increased only slightly over the life of a vehicle.

He said that it was often argued against the electric vehicle that not only was its first cost higher than that of a motor-bus, but that there was, in addition, the cost of all the fixed equipment along the route. However, as an increased life of about 25 per cent. could be expected of a trolley-bus, interest charges during the loan repayment period would be less than in the case of a motor-bus and experience had shown that the interest charges on the overhead system were more than covered by the saving in running costs.

DISCUSSION

MR. A. HADDOCK (Yorkshire E.B.), the first speaker in the discussion, quoted some figures from Sheffield as an example of the contribution which the traction load could make towards improving the load factor of the supply industry. Sheffield, he said, had a very heavy industrial load and had had an electric traction system, which was being replaced by motor buses. In 1948, before that replacement began, the Sheffield transport undertaking consumed 43 million kWh per annum with an annual load factor of 35 per cent and a maximum demand of 14,000 kW which varied very little throughout the year. The ratio of the traction demand at system peak to the system m.d. varied, but a reasonable average was 0.9. The daily maximum demand of the traction load occurred before 9 a.m. and after 5 p.m., the system maximum demand, as a result of the industrial load, being between 10 and 11 a.m. and between 4 and 5 p.m. in winter. In the winter of 1955 the traction load m.d. had shrunk to 10,080 kW, while the maximum demand at the time of system m.d. was only 5,724 kW. These typical figures showed that the road traction load was worth fighting for.

Mr. C. J. Corson (B.E.A.M.A.) believed that traffic congestion would lead to the allocation of particular streets exclusively to public service vehicles. Then the natural choice was the tramcar for heavy traffic and the trolley-bus for lighter services, the diesel having its proper sphere on feeder services from outlying areas to the terminus of the electric track.

As showing the means by which the wonderful performance and comfortable riding of modern electric road vehicles was achieved, he described the bogie of the Blackpool rail-coach. This had wheels of the rubber sandwich type, and magnetic track brakes between the wheels on each side. Each bogie had a pair of high-speed motors rubber-mounted on the sprung framework of the bogie and ball and roller bearings were used throughout.

Mr. R. D. Reynolds (E.V.A.) pointed out that electric rail traction for passengers was the most economic user of surface space, did not depend on imported fuel and was not guilty of air pollution. Electric rail and trackless vehicles were virtually silent.

Many railway branch lines now being abandoned could serve a most useful purpose as tramways or light railways, and the time to do this was now, not after the big schemes had been completed. Tramways should be used where the number of passengers exceeded 2,500 an hour in one direction at peak periods and the mean utilisation of the service did not fall below half that figure, and trolley-buses where the number was between 800 and 2,500 and the mean utilisation was not less than 30 per cent of the maximum figure.

Mr. J. H. Cansdale, in reply, made the point that the case for the electric road vehicle, though good, was not so strong as the case for railway electrification, which was overwhelming.

Battery Vehicles

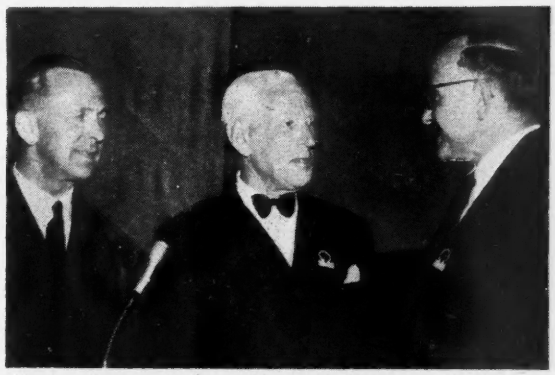
THE next paper dealt with "Battery Electric Vehicles." The authors were : H. W. Heyman (Smith's Delivery Vehicles, Ltd.), P. Rochs (Austin Crompton Parkinson Electric Vehicles, Ltd.), and H. R. Simpson (T. H. Lewis, Ltd.), and the paper was presented on behalf of the Electric Vehicle Association of Great Britain, by Mr. V. W. Dale, chairman of the Association. The authors said that when the secondary cell was introduced in 1881 it was applied to transport. The first public transport vehicles to be driven by accumulators were passenger cars on rails. About the end of the last century and the beginning of this one, battery electric private broughams and taxis were in use in France and England. By the end of the first world war battery electric vehicles were being used for delivery services and their use had changed from that of passenger to goods vehicles and also to public service refuse collection. Most of the vehicles then produced were in the heavy class. After 1930 a light type of delivery vehicle came into use which led to a great increase in the number of battery vehicles on the road.

The battery electric vehicle was supreme in short-run frequent-stop service. Delivery costs were a serious item and a saving in these of five per cent. could increase the profit by ten per cent. The electric vehicle scored heavily in reducing delivery costs and its efficiency remained constant throughout its life.

Battery electric vehicles were designed for delivery work; the characteristics of the electric motor gave rapid acceleration between stops and a higher average speed than other vehicles on this class of work. Speed of delivery service was increased through design features providing low deck height with easy loading and unloading, easy entry and exit, and no stacking delays.

The electric vehicle was not affected by the weather, it had a long, trouble-free life and was silent, free from fumes, oil and engine dirt, and it did not consume fuel when standing. Little routine maintenance was needed and major overhauls were rarely necessary. Insurance rates were 25 per cent. lower, which confirmed its lower liability to accidents.

More than thirty different trades employed "electrics" and a great many uses had been found for electric vehicles both driver-seated and pedestrian-controlled in factories, public utility, municipal and railway service, in agriculture and in hospital service. Electric vehicles operated successfully in hilly districts; many were used, for example, in hilly cities like Bristol and Sheffield. The author gave one example which showed a saving of £98 per annum in favour of an electric vehicle used for bread delivery against a comparable petrol vehicle.



Monday afternoon speakers : Messrs. H. W. Heyman, V. W. Dale and J. H. Cansdale.

Road-licensed electric vehicles alone used 165 million kWh in 1954, nearly all taken during the night. Full development could result in a large increase in this valuable load. In addition, a big field awaited development in public services, in industry and for battery railed vehicles as locomotives in mining, quarrying, shunting and for passenger work.

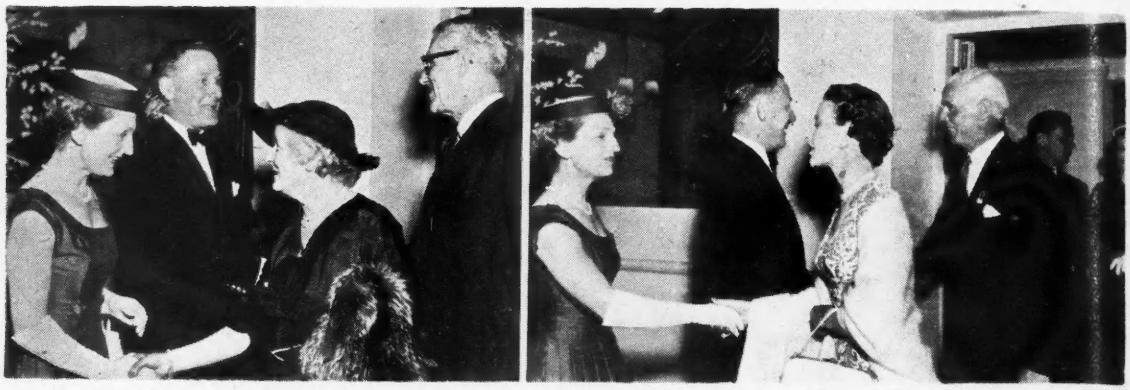
Since 1947 there had been great progress in the quality of electric vehicles. The number of electric road vehicles in use doubled between 1947 and 1954 and some milk distributors now used as many as 1,000 vehicles. The number of road-licensed vehicles in use alone exceeded 30,000. A great many more electric vehicles of all types could undoubtedly be used.

DISCUSSION

MR. V. W. DALE (chairman, E.V.A.), who presented the paper, suggested that it was because the Government recognised the validity of the authors' fundamental arguments that his Association had been able to persuade the Chancellor of the Exchequer in his 1953 Budget to grant total exemption from purchase tax to all electrically-propelled goods road vehicles.

Mr. R. Birt (N.R.E.I.C.) thought that the authors' estimate of the life of battery electric vehicles at 10-12 years was unduly pessimistic ; the life was nearer 20 years, and vehicles over 30 years old were still running in London. The authors estimated that in 1951 there had been some 400,000 short-haul vehicles. Assuming an average consumption of 10,000 kWh

Left : Mr. and Mrs. A. H. Carmichael with Mr. and Mrs. R. W. C. Reeves. Right : Mr. and Mrs. H. S. Pocock, Mr. E. J. Vidler and Mr. and Mrs. S. E. Goodall at the C.M.A. reception



Mr. and Mrs. S. F. Steward (L.D.C.) greeting (left) *Col. and Mrs. B. H. Leeson and* (right) *Mr. and Mrs. O. M. Robson.*

per annum for a battery vehicle, this meant a potential goal of 4,000 million kWh for the supply industry, and all off the peak.

Before the war and up to 1948 he had had experience of battery electrics for the delivery and servicing of electrical equipment. For delivery a 13 cwt vehicle with nickel-iron batteries had been used, and for smaller apparatus and maintenance a 15 cwt vehicle with lead-acid batteries ; and by using quick-replacement batteries a mileage of up to 60 a day on maintenance work could be obtained. Many coal merchants used battery vehicles, the G.P.O. had recently ordered a number for parcels delivery and he hoped once again to see electric taxis in the larger towns.

Mr. S. J. Emerson (Senior Electrical Inspector of Factories) said that at present on airfields, in mines and in many factories where there was a potential hazard practically all the vehicles were oil driven. In electric vehicles which were being developed all the electrical components were certified flameproof and constructed to the appropriate British Standard, and the batteries were slightly modified, having double instead of single connections. The vehicles, while not absolutely flame proof, were safe for almost all gases used in industry except acetylene, carbon bisulphide and hydrogen. The only problem had been the introduction of a properly ventilated battery system, and he understood that that had been overcome.

Mr. H. G. A. Ross-Wilson (B.E.A.M.A.) said that before the war a battery vehicle could be operated at half the cost of the equivalent petrol vehicle. It was still cheaper than the petrol vehicle, though not by such a substantial margin. Many advocates of the electric vehicle hoped for some revolutionary storage battery development which would enable a far greater number of kWh to be stored for a given weight, and this might well be achieved before long. In the meantime he had looked for a more efficient type of battery charging system and visualised a constant voltage charger embodying a transductor circuit and employing the new germanium rectifier. He believed that it would be possible in that way to obtain an overall efficiency of over 90 per cent, as compared with about 65 per cent for present-day chargers.

Mr. F. W. Mann suggested that the use of the nickel-iron type of battery would greatly increase the demand for electric vehicles in this country. Exports had absorbed a steady increase in output, but now this type of alkaline battery was becoming available at home and, as it would be backed by a ten-year guarantee, it should stimulate the demand for battery vehicles here. It was undesirable to install a lead acid battery in a vehicle designed for an alkaline battery, or vice versa. On the industrial truck, however, it was possible to use either for a common design of truck.

Mr. J. B. Blacknell (E.V.A.) mentioned some of the imponderable advantages of the electric vehicle as compared with the internal combustion engine vehicle. The first of these was its availability for 365 days in the year. It required very little maintenance. Another advantage was its simplicity ; there was only one moving part in the power unit, compared with about 300 in the internal combustion engine. Closely related to this was the saving in labour. Although the lead-acid battery was supplied with only a four-year guarantee, many batteries lasted from six to nine years ; this reduced the battery cost for an electric vehicle with a 10 cwt pay-load to about 10s. a week and the expected life of the vehicle as a whole might reasonably be taken as 20 years.

Mr. H. W. Heyman, replying to the discussion, said that the vehicle builder would fit any battery that the customer specified, but nickel-iron batteries cost three or four times as much as the lead-acid type. They needed a different chassis, larger motors and larger control equipments. Over a period of, perhaps, 20 years the use of the nickel-iron battery might be advantageous, but customers were not willing to look so far ahead. He agreed that there was a tremendous field for battery vehicles at airports, and they were so used, for instance, at the Zurich airport and the E.V.A. intended to advertise this application in the specialised overseas airport journals. Battery vehicles were coming into increasing use in Canada, where the price of petrol was only a fraction of the price in this country, and the Swiss and German Post Offices used them on a large scale.

Annual Dinner

THE annual dinner of the Convention was held at the Palace Hotel, Torquay, on 28th May, with Sir John Dalton, the President, in the chair. The principal guest was Lord Brabazon of Tara, who, in proposing the toast of " The Electrical Industry," recalled that as Parliamentary Secretary to the Ministry of Transport, he had been concerned with the work of the Weir Committee and the 1926 Electricity Act, which had involved a great deal of complicated legislative work. It was there that he first met Mr. Dalton (as he was then), a young man who knew everything and could explain everything and who had a very curious soothing effect on everyone he encountered. It had been due entirely to Mr. Dalton that he had been able to answer awkward questions and give a sound technical explanation to Members of Parliament who did not understand a word of it.

That had been the birth of the Central Electricity Board, a great and imaginative conception. Their policy then had been that generation and bulk selling should be the business of the Board, but that the retailing should be carried out by the undertakers. Since then others had had different ideas, but it was interesting to find that after thirty years the Herbert Committee recommended a return to the original principle.

Restriction of capital expenditure by the great elec-

1—Alderman I. J. Hayward, Mr. D. P. Sayers, Lord Citrine, Councillor H. T. Fullwood and Alderman A. E. Bennett. 2—Messrs. H. W. Grimmitt, C. H. E. Ridpath and T. G. Christie. 3—Messrs. A. E. Taylor, W. R. Greves and H. J. Bennett. 4—Messrs. I. F. Young, V. A. Pask, C. A. Cameron-Brown, R. A. S. Thwaites, V. W. Dale and W. J. Jones. 5—Sir David Brunt, Sir Henry Self and Mr. H. Coward. 6—Messrs. E. W. Raby and A. Cooke. 7—Messrs. W. Wilde, B. Farnworth and J. G. Bentley. 8—Mr. Forbes Jackson, Mr. and Mrs. W. E. Gibbs and Mr. R. J. Willoughby. 9—Messrs. R. F. A. Baldwin, D. T. Leathwood, H. L. Maddick and C. Boyles. 10—Messrs. A. E. Nicol, T. W. Child and H. H. Spencer. 11—Mr. W. T. Langfield, Alderman W. J. Bennett, Mr. R. W. J. Benyon and Alderman F. H. Stone.

The "panel" at the Electrical Forum: Sir Henry Self, Mr. Norman Elliott, Mr. D. Bellamy, the President, Sir Vincent de Ferranti, Mr. S. E. Goodall and Mr. H. H. Mullens

tricity industry seemed a crazy policy. He was also worried by the fact that restrictions had been put on E.D.A., whose president he had been for five years. He had great affection for E.D.A. and its director, Mr. Victor Dale.

Referring to his varied transport experience, Lord Brabazon said that it was a tragedy that with all the tremendous advances in electricity there had been little advance in the secondary battery. It would have changed the whole complexion of transport on the roads if the secondary battery had advanced with the same rapidity as the petrol engine.

The electrical industry was to be congratulated on exporting goods to the value of £250 million last year—a remarkable achievement in the face of every form of discouragement from the Government, including the Restrictive Practices Bill, which seemed to him extremely unnecessary. There could not be much wrong with an industry which could beat the world on price in the export market.

It would not be long before electric power became available from nuclear heat. The next step would be the generation of electricity direct from nuclear fission, and there would then be available a primary battery which had never been dreamt of before.

The President, who responded, said that the value of the annual Power Conventions could not be assessed. Like most great industries, the electrical industry was becoming specialised. To meet at the Convention once a year and learn the other fellow's point of view was something which could not be done over the telephone between Belfast, Jersey or Scotland and London.

The toast of the guests was proposed by Colonel B. H. Leeson, C.B.E., who referred to the fact that the Convention, which was such a wonderful cross-section of the great electrical industry, had sprung from the old days of the Incorporated Municipal Electrical Association. It was a good thing now and again to look back and pay tribute to those predecessors and it was in that spirit that he mentioned the presence of two past-presidents of the I.M.E.A., Mr. W. J. Bache and Mr. F. Newey.

The Mayor of Torquay (Councillor Isidore Joseph) briefly responded to the toast.

Electrical Forum

THE customary Electrical Forum took place on the last morning. The members of the "Panel" were Mr. D. Bellamy, Mr. N. Elliott, Sir Henry Self, Mr. H. H. Mullens, Mr. S. E. Goodall and Sir Vincent de Ferranti.

There were a dozen or so pertinent questions and answers although surprisingly none or very few of them were related to the theme of the Convention. Two questions related to the Herbert Report—should tenders be invited from abroad and what about Electricity Board Districts' autonomy? Sir Vincent said he found it deplorable that the committee should try to throw a spanner in the works of the electrical industry as a whole and Mr. Elliott could not see how foreign manufacturers could buy from us if we did not buy from them.

Dealing with the question of the visit of the Russian electrical engineers to this country Sir Henry Self thought it did an amazing amount of good, but Mr. Goodall sounded a cautious note.

On the question of the call for further capital expenditure by the National Coal Board Sir Henry Self stressed that until we had a fuller measure of nuclear energy we had got to live on coal and Mr. Elliott thought that we should aim at competition between coal and nuclear energy. Another question related to the shortage of technologists.

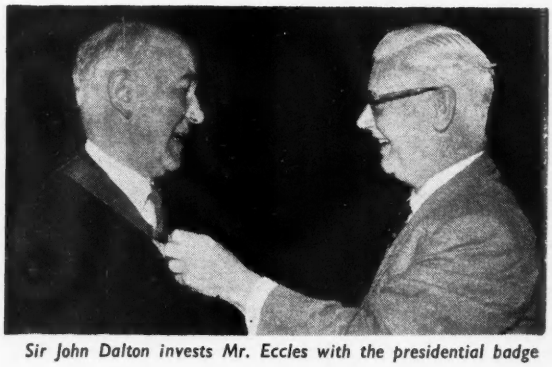
A fuller report will be published next week.

Annual General Meeting

THE last item in the Convention proceedings was the annual general meeting on Tuesday. After getting over the formal business Sir John Dalton announced the nomination of Mr. J. Eccles as the next President, describing him as "a brilliant engineer and a charming man." The nomination was approved with acclamation, as was the choice of Sir George Nelson, Bt., as the new vice-president. Sir John read a letter from Sir George Nelson expressing his regret at his inability to be present owing to absence on business in North America.

Sir John then reported that the Council had decided that next year's Convention should be held at Eastbourne during the week commencing on Monday, 17th June. He expressed the Convention's thanks to the Mayor and Corporation of Torquay, the Town Clerk, the Manager of the Pavilion, Messrs. Irens and Allwood (South Western Electricity Board), Messrs. Bellamy and Dale (E.D.A.) and Messrs. Bird, Boyes and Welch, who organised the golf competition.

Sir Henry Self proposed, in most felicitous terms, a vote of thanks to Sir John and Lady Dalton, who had made the Convention such an outstanding success.



Sir John Dalton invests Mr. Eccles with the presidential badge

Smaller Electricity Surplus

Lord Citrine's Warning of Higher Charges

A CONFERENCE of representatives of the Central Electricity Authority, Area Electricity Boards and Consultative Councils who were attending the British Electrical Power Convention at Torquay was held in the Marine Spa Ballroom on 24th May when the chairman, Lord Citrine, intimated that although the financial results for 1955-56 were not yet available it was certain that the year's surplus would be much smaller than the consolidated surplus of over £18½ million recorded in the 1954-55 report. (This included £389,000 for the South West and South East Scotland Electricity Boards now merged in the separate South of Scotland Electricity Board.) Lord Citrine said that in view of coal price increases announced or pending, there was little doubt that, unless the industry was to be involved in deficits, the Area Boards would have to raise their tariffs soon.

Surveying progress during the year, Lord Citrine said that nearly half a million new consumers were connected, bringing the total to 14,148,000, and sales increased by 9·4 per cent.

Fuel Saving by Increased Efficiency

At 31st March last, the Authority owned 273 power stations with a total installed capacity of 20,644 MW and a total maximum output capacity of 18,873 MW. A record figure of 1,721 MW (s.o.) of generating plant was commissioned, including 56 MW commissioned by the South of Scotland Board. The maximum demand supplied was 16,693 MW on 20th February, as compared with 15,370 MW in the winter of 1954-55. The maximum potential demand was 18,100 MW on 2nd February, compared with 15,900 MW in 1954-55. The average thermal efficiency for the Authority's steam power stations rose from 23·83 to 24·01 per cent; this enabled approximately 850,000 tons of coal to be saved, which would have cost over £3 million.

The development of the 200 MW unit for the High Marnham power station was continued and work was commenced on the development of the outline design of two further 200 MW unit stations. As it would probably be advantageous to use nuclear generation for supplying base load, and non-nuclear plant must be suitable for two-shift operation, this new requirement was reflected in both turbine and boiler design. The plant programmes had been reviewed to substitute larger units wherever practicable so as to secure the maximum reduction in capital and operating costs. As a result, some twenty-six 60 MW units planned for installation in five power stations were being replaced by thirteen 120 MW units.

Approval was given during the year to the construction of further sections of the 275 kV system, and probable developments of the system between 1960 and 1970 had been studied.

The total consumption of fuel in the Authority's power stations during the year was 6·6 per cent higher than in 1954-55 while the increase in electricity generated was 9·4 per cent, reflecting the further improvement in the efficiency of generation.

The continuing shortage of British coal necessitated the use of imported coal by the Authority, but the scaling down of coal imports during this summer, on the Government's instructions, would necessitate a major change in the pattern of inland coal supplies. The average delivered cost per ton of fuel consumed in the Authority's steam stations was 10·9 per cent higher than in 1954-55.

The Authority had made arrangements with two oil companies for the supply of fuel oil on a ten-year contract for consumption at sixteen power stations. For reasons of capital economy oil-firing equipment only was being provided at some of the stations under construction, but coal handling plant could be installed later if required. For the same reasons, the Authority's view had been submitted to the Minister that the recommendations of the Beaver Committee on Air Pollution on the installation of gas washing and grit arresting plant should not be enforced at the expense of productive capacity. The Authority's investigations into atmospheric pollution in the vicinity of power stations had continued.

Nuclear Power Stations

Responsibility had been accepted by the Authority for the construction of twelve nuclear power stations in the ten years up to 1965. Construction of the first two stations would begin in 1957. Sites had been selected at Bradwell-on-Sea, Essex, and Berkeley, Gloucestershire. Tenders for construction of the complete stations were being submitted by groups of manufacturers and consideration was being given to improvments for incorporating in later stations.

Lord Citrine opening the C.E.A. and Electricity Boards' meeting at Torquay on Thursday last week

The main objectives in the research and development programme of the Central Authority and the Area Boards for 1956-57, which had been submitted to the Minister of Fuel and Power, included improvements in availability of generating plant, efficiency of generation and improvements in the techniques of transmission and distribution. In the field of utilisation research a recent analysis of a sample of roughly 12,000 domestic consumers yielded valuable results, and tests had also been carried out with shop and small industrial consumers. Operational research required considerable expansion and discussions had taken place with trade unions and employees. Development continued at headquarters and in the Divisions.

In response to representations from the Chancellor of the Exchequer, the Authority had agreed to reduce its capital requirements for 1956-57 by some £19 million, the reduction to fall fairly evenly on generation and distribution.

Skelton Grange Output Record

THE Skelton Grange "A" power station of the Central Electricity Authority, Yorkshire Division, contains six 60 MW Parsons turbo-generators. These machines were installed between 1951 and 1955 and are typical of the many sets which C. A. Parsons & Co., Ltd., have installed both in this country and abroad. The machines, comprising three-cylinder all reaction type turbines coupled to hydrogen cooled generators, operate with steam at a pressure of 900 lb/sq in and 925 deg F.

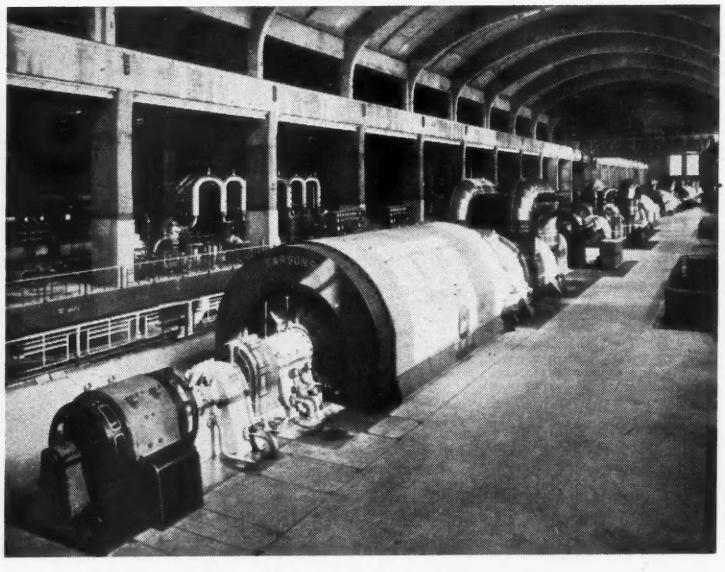
A report on the operation of the Skelton Grange plant issued by the Yorkshire Division states that during the week ended 9th December 50,436,200 kWh was generated by the five turbo-alternators then installed. This was equivalent to a generating plant load factor of over 100 per cent, which means that the machines carried a little over full load for the whole seven days and nights. Plant load factors of over 100 per cent have been attained before, but usually on smaller sets in smaller stations. It is very doubtful whether a load factor of 100 per cent has ever before been associated with an output of over 50 million kWh.

No. 6 alternator was synchronised for the first time on 14th December and then more records were achieved. During the week ending 6th January 58,078,300 kWh was generated. This was the greatest output ever produced by a single power station in this country. Since then, however, the Skelton Grange station has twice beaten its own record, 59,346,700 kWh being generated during the week ending 20th January and 59,629,400 kWh (56,478,600 sent out) in the week ending 27th January, equivalent to a load factor, on a sent-out basis, of 100·05 per cent.

During the latter week the kWh sent out from Skelton Grange represented 26·34 per cent of the kWh from the stations in the Division and 3·34 per cent of the total sent out from all the stations in the country. A further basis of comparison is provided by the fact that the average weekly consumption of the Leeds District of the Yorkshire Electricity Board during January was approximately 14½ million kWh.

Whilst producing its record output Skelton Grange retained its position as the station with the lowest fuel cost in the country per kWh sent out. In order to produce the 59,629,400 kWh, no fewer than 28,983 tons of coal were consumed which included 5,746 tons of fines, dusts and slurry and 2,808 tons of opencast. The average calorific value was 10,132 B.Th.U./lb and the overall thermal efficiency of the station was 29·28 per cent. Of this quantity of coal 12,940 tons arrived by road and 16,043 tons came by rail.

The statement by the Yorkshire Division goes on to say that these figures provide some illustration of the magnitude of the task and the performance reflects great credit on all concerned with the operation and also construction of the station, the system operation department and the divisional transmission section.



General view of the turbine room in Skelton Grange generating station

Proposed Istanbul "Underground"

THE *Monthly Trade Journal* of the British Chamber of Commerce of Turkey says that after more than a year's work, which included taking soundings and subsoil specimens, the French company engaged by the Istanbul Municipality to prepare plans for the projected Istanbul underground railway has now handed them over to the Municipality.

The plans are now being studied by municipal engineers but are understood to provide for a total rail length of 12½ km, 11·7 km of which would be underground. The Golden Horn would be crossed by a third bridge and the estimated overall cost of the project, which allows for the transport of 35,000 passengers per hour, is said to be £T177 million (about £23 million sterling).

Surface traffic congestion in the city has reached a point where delays must cause huge financial losses every year but in the face of the Government's restrictions on capital expenditure it would seem doubtful whether an early start on this project can be expected.

New Malayan Power Station

THE Singapore correspondent of *The Times* reports that in opening the new Connaught Bridge power station in Selangor State on 26th May, Mr. C. G. Harrison, chairman of the Central Electricity Board, Malaya, said that the country would have to rely on the development of nuclear fuel for further sources of power. The capacity of the Connaught Bridge station (80,000 kW) would be fully absorbed by the end of 1958. At that time the demand would be expanding and it could be met only by nuclear power. Mr. Harrison said that the main reasons why the demand would accelerate were that the population was increasing rapidly, and the need for a more balanced economy, which in turn required the development of secondary industries.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Minister of Fuel and Power has appointed **Mr. G. H. R. Martin,** A.M.I.E.E., M.Brit.I.R.E., of East Grinstead and Faraday House, London, to be deputy chairman of the London Electricity Consultative Council in succession to **Mr. W. Howes,** M.I.Mech.E., M.I.E.E., of Streatham Common, who retired on completion of his term of office on 14th May.

Dr. **T. E. Allibone,** D.Sc., F.R.S., M.I.E.E., of Newbury, Berks, **Lt.-Col. R. P. Dent,** A.M.I.Mech.E., of Farnham, Surrey, **Commander A. V. de Labalmondiere,** R.N., of Portesham, nr. Weymouth, **Mr. H. E. Mills,** of Pewsham, nr. Chippenham, **Mr. A. R. Moody,** of Lower Swanwick, nr. Southampton, and **Mr. E. A. Wymer,** B.Sc., B.Com., of Oxford, have been appointed members of the Southern Electricity Consultative Council.

Alderman E. W. B. Gill, O.B.E., M.A., B.Sc. (deputy chairman), of Oxford, **Alderman A. C. Billett,** of Weymouth, **Mr. W. E. Brandreth,** A.M.I.E.E., of Chieveley, nr. Newbury, **Mr. A. Ford Young,** D.S.O., of Crondall, nr. Farnham, and **Mr. W. J. Marsh,** J.P., of Yeovil, retired from the Council on 31st March on completion of their terms of office. The Minister has appointed **Mr. E. Hyman,** J.P., of Southampton, as deputy chairman of the Council in place of Alderman Gill.

Thorn Electrical Industries, Ltd., announces that **Lt.-Col. D. J. Goldsmith,** after completing twenty-five years as a regular officer, has joined the "Atlas" lighting division as assistant to the general sales manager. Lt.-Col. Goldsmith spent three and a half years as a prisoner of war in Siam and subsequently served as military secretary to the Governor of the Central Provinces and Berar in India.

Lt.-Col. D. J. Goldsmith

The B.B.C. announces that **Sir Harold Bishop,** Director of Technical Services, will in future be known as Director of Engineering.

Sir Wavell Wakefield, M.P., was elected president of the Electric Vehicle Association of Great Britain, for the third year in succession, at the annual general meeting held in London on 9th May. The new chairman is **Mr. V. W. Dale,** Comp.I.E.E., director and secretary of the Electrical Development Association, the vice-chairman **Mr. J. A. Lowe,** Westinghouse Brake & Signal Co., Ltd., and the hon. treasurer **Mr. H. E. M. Bull,** S.E.V. (Sales & Services), Ltd., Gateshead-on-Tyne.

Mr. E. J. Scotcher, B.Sc.Tech., A.M.I.E.E., has been appointed assistant superintendent, Control Department, of the Metropolitan-Vickers Electrical Co., Ltd. Mr. Scotcher was educated at Blackpool Grammar School and the University of Manchester. He served with the Royal Electrical & Mechanical Engineers from 1947 to 1949, and then joined M-V as a college apprentice. On completing his course in 1951 he was appointed development engineer, Control Department.

Mr. E. J. Scotcher

Mr. W. E. Gee

Mr. W. E. Gee has been appointed assistant traffic manager (export). Mr. Gee joined Metropolitan-Vickers in 1931 as a trainee in the Traffic Department. After gaining practical experience in packing and shipping by rail, road and sea, he joined the export side of the Department in 1936. In 1947 he was appointed chief export clerk, and since then he has been directly responsible for all overseas shipments.

Mr. J. Winton has been appointed assistant to the general sales manager (office equipment) of Remington Rand, Ltd.

Mr. J. P. Kelly, B.Sc., who has been a lecturer on the staff of the Electrical Engineering Department of the Heriot-Watt College, Edinburgh, for thirty-six years, is retiring at the end of the present session, and it is proposed to recognise the outstanding services that he has performed for former students and for the electrical industry generally, by instituting a "J. P. Kelly Prize" which will be given annually to the best student in the electrical technology day class. It is hoped to inaugurate the prize and at the same time make a presentation to Mr. Kelly at a meeting to be held in the Heriot-Watt College on 27th June. Messrs. C. H. A. Collyns and W. B. Laing have issued an appeal to former students for contributions to the prize and presentation to Mr. Kelly. It is suggested that contributions between 5s and £1 would be appropriate, and it is asked that these should be sent to Mr. W. M. McKenzie, secretary, Bruce Peebles & Co., Ltd., Edinburgh, 5, by 15th June. Mr. Kelly will also be presented with a book containing the signatures of all contributors, and for this purpose with each appeal a gummed slip is issued.

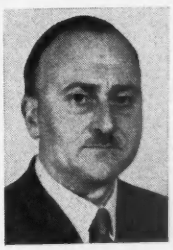
Mr. Miles Beevor, deputy chairman and joint managing director of the Brush Group, Ltd., left for Canada on 22nd May. During his visit his objective will be to stimulate the dollar sales of companies within the group. He hopes to arrive home on 13th June. Mr. Beevor is accompanied by **Mr. M. C. Clear,** group sales director, and, to Vancouver, by **Mr. R. H. Hainsworth,** managing director of J. & H. McLaren, Ltd., Leeds, one of the group's manufacturing subsidiaries.

Following the death of Dr. S. Whitehead, the Council of the Electrical Research Association has appointed **Mr. L. Gosland** and **Mr. H. M. Lacey** as joint acting directors until a new appointment is made.

Mr. F. J. Burns (Cryselco, Ltd.) has been elected chairman of the Liverpool Centre of the Illuminating Engineering Society in succession to **Mr. G. L. Butler.**

Mr. J. R. Sharp, national chairman of the Institute of Materials Handling, has left for the United States with **Mr. J. Bright,** past-chairman, to attend the American Materials Handling Exposition at Cleveland, Ohio. Mr. Sharp is joint governing director of Lansing Bagnall, Ltd., Basingstoke.

Mr. Clifford Smith, A.M.I.E.E., has been appointed manager of the Marine Department of the General Electric Co., Ltd. He was educated at Bell's Grammar School, Gloucestershire, and at Faraday House Electrical Engineering College, London, where he was awarded his diploma. He served one year's apprenticeship with Fielding & Platt, Ltd., Gloucester, and joined the Witton Engineering Works of the G.E.C. as an apprentice in 1931. On completing



Mr. C. Smith

his apprenticeship he was transferred to the Estimating Department of the company and specialised in the preparation of tenders for all types of marine equipment. In 1934 Mr. Smith transferred to the G.E.C. Marine Department at the company's head office as a junior engineer under the late Mr. C. W. Saunders, and from 1948 until December, 1955, was electrical engineering assistant to the late Mr. C. P. Harrison, whom he now succeeds.

A member of the Territorial Army from 1937, Mr. Smith served in the Forces from the outbreak of hostilities and was commissioned in the Royal Artillery in 1941. Demobilised in 1945 with the rank of captain, he rejoined the G.E.C. to resume his specialised duties in the Marine Department.

At the request of the Council of the Institute of Export, which this year is celebrating its twenty-first birthday, **Mr. Leslie Gamage,** vice-chairman and joint managing director of the General Electric Co., Ltd., has agreed to continue as president of the Institute for this his fourteenth consecutive year.

Under the G.E.C. scholarship scheme initiated in 1955, scholarships this year have been awarded to the following:—**Mr. P. Bryant,** of the Research Laboratories, Wembley, for research into electrical communications network theory at Cambridge; **Mr. L. Jones,** of the Planning Department of the Witton Engineering Works, Birmingham, to follow the post-graduate course in engineering production at Birmingham University; and **Mr. J. Burton,** of the Overhead Lines Department at the Pirelli-General Cable Works, Ltd., Southampton, to complete his professional engineering studies.

Mr. W. M. York has been elected to the board of directors of E. K. Cole, Ltd. Formerly an executive director of the company, Mr. York has been appointed to the post of commercial director. He joined E. K. Cole, Ltd., in 1932 from Alvis, Ltd., where he was publicity manager, and has been in charge of Ekco publicity for the past twenty-four years. In 1951 he was appointed an executive director of the company, covering publicity and the Thermovent Heating Division, and early last year he became additionally responsible for Ekco overseas commercial activities.

Mr. W. M. York

For the fourth time in five years the Ekco team (**E. K. Cole, Ltd.**) won the challenge shield at the Essex Business Houses Association's tenth annual athletic championship meeting at the Briggs Social and Athletic Club sports ground, Romford, on 19th May.

The North Western Branch of the **Electrical Trades Commercial Travellers' Association** will hold its annual bowling match on 6th June (6.30 p.m.) at the Eagle and Child Hotel, Higher Lane, Whitefield.

The East Midlands Area ball of the **Electrical Industries Benevolent Association** will be held on 6th December at the Leicester Palais de Danse. The event is being organised by the Leicester Branch Committee.

OBITUARY

Mr. W. N. Duffy.—We report with regret the sudden death on 24th May, while he was attending the British Electrical Power Convention at Torquay, of Mr. W. N. Duffy, N.R.D., M.S.I.A., F.R.S.A., publicity manager to Ferranti, Ltd. Mr. Duffy was born in London in 1898 and was educated at the Royal College of Art, South Kensington. From 1920 to 1923 he was a sculptor and modeller with Messrs. Balliscombe & Harris and was then with Liberty & Co. as a designer from 1923 to 1932. He was appointed chief industrial designer to Ferranti, Ltd., in the latter year and became publicity manager in 1951. Mr. Duffy had been chairman of the Manchester Region of the Design and Industries Association and he represented the electrical industry (with Mr. F. Winstanley, G.E.C.) at the Board of Trade inquiry which led to the formation of the Council of Industrial Design.

The late Mr. W. N. Duffy

Mr. Charles George Carrothers, M.I.E.E., M.I.Mech.E., who for the greater part of his life had been on the staff of Messrs. Kennedy & Donkin, consulting engineers, and for some years had been head of the Research Department, was killed as the result of a motor accident on 22nd May whilst motoring in the Birmingham area with Mrs. Carrothers, who was seriously injured.

Mr. Carrothers was born in 1892 and was educated at Liverpool College. After a three-year apprenticeship with Clarke, Chapman & Co., he took a course in engineering at Liverpool University where he obtained a B.Eng. degree. He enlisted in 1914 and later took a commission in the Royal Engineers. In 1920 he joined Messrs. Kennedy & Donkin as an assistant engineer and from then until 1927 the greater part of his time was spent in Calcutta as deputy, and later as senior, representative of his firm supervising the extensions to the generating stations and transmission system of the Calcutta Electric Supply Corporation. After returning to England he was engaged mainly on technical investigations in connection with the construction of the 132 kV transmission system of the Central Electricity Board. From 1938 to 1942 Mr. Carrothers was senior technical assistant with the Edinburgh Corporation Electricity Department and in 1942 he rejoined Messrs. Kennedy & Donkin.

Mr. W. Ibberson Jones, of Swindon, died on 23rd May at the age of seventy-one. He was formerly branch manager for Edwards & Armstrong, Stroud, which later was merged with Edmundsons. He founded the business of Teesdale & Jones, electrical engineers, Swindon, in 1921.

Mr. F. J. Bray.—The death has occurred of Mr. Frederick John Bray, who was principal of the electrical engineering business of Bray & Co., Earl Shilton, Leics. He was seventy years of age.

WILLS

Mr. P. E. Smith, A.M.I.E.E., former borough electrical engineer and manager at Ilford, who died on 3rd March, intestate, left £6,656 gross (£6,566 net).

Mr. C. P. Harrison, manager of the Marine Department of the General Electric Co., Ltd., formerly of the G.E.C. Witton Engineering Works, Birmingham, who died on 29th January, left £14,090 gross (£12,348 net).

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £189 0s 0d
COPPER, H.C. Electro	ton £309 5s 0d
Fire Refined 99·70%	ton £308 0s 0d
Fire Refined 99·50%	ton £307 0s 0d
COPPER Tubes ..	lb 3s 0⅜d
Sheet	ton £376 5s 0d
H.C. wire and strip ..	ton £341 5s 0d
LEAD, English ..	ton £112 0s 0d
Foreign	ton £111 0s 0d
MERCURY	flask £87 0s 0d
TIN, block (English) ..	ton £742 0s 0d
ZINC, G.O.B. Foreign	ton £93 15s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 5⅛d
Sheet	ton £302 15s 0d
Wire	lb 3s 0⅛d
PHOSPHOR BRONZE Wire	lb 4s 6⅛d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 22⅜d—22½d

TECHNICAL CIVIL SERVANTS

The Society of Technical Civil Servants is holding its annual conference at the Royal Pavilion Theatre, Brighton, from Sunday next until Tuesday, 5th June. An address on technical education will be given on Monday by Professor Sir Solly Zuckerman, deputy chairman of the Advisory Council on Scientific Policy.

VIEWS on the NEWS

By REFLECTOR

WHATEVER organisers of conferences and other such affairs may consider to be of the greatest moment the daily papers will continue to seize on what they think will tickle the public palate. An example of this was seen last week when of all the interesting matter available at the British Electrical Power Convention the point which secured the most publicity was Lord Citrine's warning that the price of electricity must inevitably be raised to meet increasing costs. It was most unfortunate that this was presented to the public at the time of a conference designed to put electricity "on the map." It resulted from the timing of the electricity supply authorities' meeting (a "private" affair, not strictly connected with the Convention at all). I know that it is very convenient to hold this annual meeting when so many electricity supply people are already gathered together but this time it would have been better if it had taken place towards the end of the Convention.

* * *

Kipling said, I believe, that "romance comes down with the 9.15." He was, of course, thinking of the dashing flamboyant steam locomotive whose day is now ending. Many will be sad at its disappearance, being ignorant of its extremely low efficiency and overlooking its noise and dirt. Will small boys of the future nourish the ambition of one day standing (or sitting) at the controls of an electric locomotive as modern boys dream of commanding a steam locomotive? At the B.E.P.C. Mr. Norman Elliott, while bound to approve of the change, nostalgically appealed to British Railways at least to give their electric locomotives names; steam locomotives have been christened from the primitive "Puffing Billy" to those of the "King Arthur" class. I back Mr. Elliott's suggestion and hope that those responsible for the electrification of our railway system will be commemorated thus for a start.

* * *

A firm of estate agents advertising regularly in the *Observer* employ an unusual style. Some of the announcements are remarkably candid and most of them are amusing. A recent one reads (in part):—

> "£3,500 fhld. Try offers! Talented Painter & Electrician's much-loved Home nr. Ealing Com. (More plugs than any house in Street. . . .)"

I have known one or two electricians who painted in their leisure time but it is surely uncommon for an artist to take up installation work as a hobby. I can only hope that all those "plugs" are properly and safely wired.

* * *

Good coal is short but still the Coal Utilisation Council is pushing its special solid fuel fires and contending that they are considerably cheaper to run than other types. Last week at a Press conference the Council's technical manager, Mr. W. C. Moss, said that a recent study showed that to obtain the same results as were given by a hundredweight of coal (costing 7s 7d) burned in a convector open fire, gas costing 14s 1d or electricity costing 13s 5d would be required. As usual, this comparison seems to have been based on continuous heating which in so many cases is not required. For shorter periods coal is not in such a favourable position. I am grateful to Mr. Moss, however, for showing that electricity is cheaper than gas for heating although, no doubt, the gas people will not be with him in this.

* * *

A lady at Rye Harbour, Sussex, has persuaded the Battle Rural Council to restore to her Council house the "old fashioned" range which was replaced by a previous tenant by an electric cooker. Apparently all the tenants on this estate have also made this change. What puzzles me in the matter is that, according to Press reports, this lady found electric cooking too expensive; it was costing her 14s a week she said. Now, taking the average load as 2 kW and putting the price of electricity at 1½d/kWh (which is pretty high), I calculate that she should have been able to use the cooker for eight hours a day for seven days a week for her alleged expenditure. She must have been heating her house as well as cooking.

* * *

I am rather puzzled by a sentence in a report from the Kent Section of the E.P.E.A. in the *Electrical Power Engineer*:—

> "The situation at Gravesend power station was still stagnating; the deficient charge engineer is conspicuous by his absence."

In what respect is he deficient? Evidently he is not so deficient that he is not missed.

* * *

Eighty years ago (1st June, 1876) the *Electrical Review* quoted a Canadian paper's remarks on the work of Alexander Graham Bell in which his telephone was perhaps first mentioned. The paper said:—

> "Professor A. Graham Bell has just obtained a patent from Washington for a new method of telegraphy, by means of an *undulatory* instead of an *intermittent* current, as employed under the former patent. Our readers will remember that during last summer Professor A. G. Bell gave, at the office of the Dominion Telegraph Company in Brantford, an exposition of his telegraphic discoveries; since then, considerable advance has been made in the improvement of apparatus, and some of the results now obtained are very striking; thus, from an electro-magnet at one end of a single wire are heard issuing the sounds of the human voice—tones and words which were spoken or sung before a membrane connected with an electro-magnet at the other end of the wire. Professor A. G. Bell's inventions, secured by patents, include:—Simultaneous transmission of a multiplicity of messages, in either direction, on a single wire: the conveyance of autographic messages in *facsimile*; the transmission of vocal or other sounds. The discoveries made by Professor Bell's researches are very startling, and when carried into practical effect will work quite a change in the telegraphic system. To carry the sound of the human voice over the mystic wire is an accomplishment never before scarcely dreamed of!"

Financial Section

STOCKS and SHARES

STOCK EXCHANGE markets have had a subdued appearance during the second half of May. No particular inspiration has come from the economic news, and chairmen's speeches at many of the company meetings being held at this time often echo in some form the cautionary note in the Turner & Newall annual report. This refers to a slightly downward tendency in sales; to evidence of the effect of the credit squeeze on orders from some quarters; and to the suggestion that the "ever forward" movement appears to have ceased for the time being, although there is no case for pessimism. An uncertain turn in Wall Street prices has also had an effect here. As a result, the accompanying share lists, which cover a fortnight's changes, indicate an easier trend in prices, but in few cases do the falls amount to anything significant.

B.T.M. and G.E.C.

The £1 shares of the British Tabulating Machine Co. (of "Hollerith" fame) were well sustained at around 49s by the announcement of a 1 per cent increase in the interim dividend for the current year and by news, on the following day, of the new joint enterprise to be formed in association with G.E.C. This will have as its objective the design of computors and other equipment for such purposes as office machinery and automation. Collaboration between the two companies is calculated to lead to significant advances in the development of these devices. Earlier the market had been favourably impressed by the report that the company continues to receive financial backing from the Finance Corporation for Industry, which has made fresh arrangements to advance sums up to £2 million. Revenue of B.T.M. has doubled in the past five years, and the latest net profit of £532,000, for the year ended in September, provided fourfold cover for the 9 per cent dividend. The yield on the shares at that rate is a little under 3¾ per cent.

Price Changes

Associated Automation (formerly Hall Telephone Accessories) 10s shares were marked down fairly sharply to 22s 6d after the declaration of a 5 per cent dividend, accompanied by the announcement of a coming share-for-share "rights" issue at 15s per share. Moderate declines in Ekco, E.M.I., Decca and Pye reflected the evidence of difficult trading conditions in the radio industry as a result of the hire-purchase and other restrictions. The same factor continued to affect shares, such as Morphy-Richards, concerned with domestic appliances. Among the leaders of the electrical equipment market, English Electrics and G.E.C. (on which the final dividend is due to be declared in July) were dull, and others which lost ground included Tube Investments, Reyrolle and some of the cable shares. Metal Industries reacted further to about 20s. Among new "rights" issues, the premium

Two Weeks' Price Changes in

Company or Board	Nom. Value	Middle price 28th May	Two Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
						£ s d		
Gilt-edged Stocks								
Brit. Elec. 1968/73	100	76½	−1	3	3	3 18 6	80½	75
Brit. Elec. 1974/77	100	75½		3	3	3 19 6	79½	73⅝
Brit. Elec. 1976/79	100	79½		3½	3½	4 8 0	84	78⅝
Brit. Elec. 1974/79	100	90½		4¼	4¼	4 14 0	95	88
Overseas Electric Supply								
Calcutta Elec.	£1	19/6	+6d	6†	6†	6 3 0†	20/9	19/-
East African Power	£1	20/-		7	7	7 0 0	21/3	20/-
Nigerian Elec.	£1	20/-	−1/-	10	10	10 0 0	21/-	17/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	Nil	21/-	21/-
Perak Hydro-Elec.	£1	16/-		10	10	—	17/6	14/9
Equipment and Manufacturing								
Aberdare Cables	5/-	11/9	−1/-	17½	17½	7 9 0	13/6	10/6
Aerialite	1/-	5/3x.d.		88½	45*	8 11 6	6/9	5/-
Allen, W. H.	£1	75/-		20	20	5 6 8	78/-	67/-
Aron Elec. Ord.	£1	56/-		15	15	5 7 3	56/-	53/6
Assd. Automation	10/-	22/6	−4/6	10	5	2 4 6	34/9	22/6
Assoc. Elec. Ord.	£1	70/-x.d.	−9d	14	15	4 5 9	85/6	57/9
Automatic Tel. & El.	£1	60/-		15	15	5 0 0	72/6	59/6
Babcock & Wilcox	£1	76/6	−6d	15	15	3 18 6	85/6	64/-
Baldwin, H.	2/-	5/-		20	20	8 0 0	5/-	3/9
Bakelite	10/-	30/-		16	16	5 6 9	34/-	26/9
Berry's Electric	5/-	6/6		—	10‡	7 13 9	6/6	5/9
British Aluminium	£1	53/-		12	12	4 10 6	57/-	40/6
B.I. Callender's	£1	51/-	+3d	10	12½	4 18 0	54/3	45/-
B.I. Callender's 6% Pref.	£1	21/9	−3d	6	6	5 10 3	22/6	20/3
British Thermostat	5/-	28/3	−6d	20	25	4 8 6	31/9	24/6
British Vac. Cleaner	5/-	6/9		30	15*	11 2 3	8/9	6/9
Brook Motors	10/-	40/-		20	25	6 5 0	44/-	40/-
Brush Ord.	5/-	7/-		10	10	7 2 9	7/9	6/3
Bulgin, A. F.	1/-	5/-	−3d	45	50	—	5/3	4/3
Burco Dean	5/-	9/6		—	22½	11 16 9	13/3	8/6
Chloride El. Storage "A"	£1	63/9	+9d	17½	17½	5 9 9	73/6	60/9
Clarke Chapman	£1	110/-	−1/3	20	22½	4 1 9	112/6	89/6
Cole, E. K.	5/-	16/3	−1/3	27½	17½*	5 7 9	22/3	16/-
Cossor, A. C.	5/-	7/6		10	15	10 0 0	10/3	6/9
Crabtree	10/-	28/6		20	20	7 0 3	29/3	27/-
Crompton Parkinson Ord.	5/-	14/6		20	16*	5 10 3	15/-	12/3
De La Rue	5/-	19/-		20	30	7 18 0	20/3	15/-
Decca	4/-	29/3x.d.	−6d	56½	43½*	6 1 9	44/9	24/9
Desoutter	5/-	27/3		25	30	5 10 0	32/9	25/9
Dewhurst	2/-	7/-		24	30	—	7/3	5/3
Dictograph Tel.	2/-	6/3		20	20	6 8 0	6/9	6/-
Dubilier Condenser	1/-	4/-		25	25*	6 5 0	4/6	4/-
E.M.I.	10/-	27/9	−1/-	10	15	5 8 0	37/-	27/-
Electrical Components	5/-	13/9		20	25	9 1 9	16/-	13/9
Elec. Construction	£1	28/9		15	8½	5 18 3	29/9	25/-
Enfield Cable Ord.	£1	15/3	−6d	Nil	Nil	Nil	19/3	14/9
English Electric	£1	53/9	−2/6	12½	12½	4 13 0	66/3	47/3
English Electric 3¾% Pref.	£1	14/-		3¾	3¾	5 7 3	14/6	12/6
Ericsson Tel.	5/-	37/-	−1/6	20†	20†	2 14 0†	42/9	33/6
Ever Ready	5/-	29/-		35	35	6 0 9	32/9	24/-
Falk Stadelmann	£1	38/9		15	17½	9 0 9	45/9	37/6
G.E.C. Ord.	£1	55/-	−2/6	12½	14	5 1 9	65/6	50/-
G.E.C. 6½% Pref.	£1	23/9		6½	6½	5 9 6	23/9	21/3
General Cables	5/-	12/9		30	30	11 15 3	13/9	12/9
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Cable	5/-	23/9		20	25	5 5 3	24/6	18/9
Hackbridge & Hewittic	5/-	19/3		25	30	—	22/-	17/3
Heatrae	2/-	4/9		12½	15	6 6 3	5/1	4/9
Henley's	10/-	17/3x.d.	−1/6	10½	11½	6 13 3	19/9	14/-
Holophane	5/-	18/9x.d.		25	30	8 0 0	19/-	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend forecast.

on British Aluminiums fluctuated between 14s 6d and 15s, and Rheostatics were 9s 9d.

Scrip Issues

A. F. Bulgin's scrip issue of one new "A" share for every two 1s ordinary shares was concluded to-day (Friday), the last day for the renunciation of allotments. These new "A" shares will rank equally with the old in all respects except that they carry no votes. They have been dealt in lately at around 5s, at which price the yield is 6⅜ per cent on the basis that the rate of the latest dividend of 50 per cent will be scaled down in proportion to the larger number of shares now ranking for the payment. In April the company reported a most satisfactory order book, giving every reason to hope for a maintenance of the successful record. Dewhurst & Partner's scrip issue, which doubles the nominal capital, was also finished this week. The new 2s shares are equal with the old and will participate in the interim dividend now due to be declared.

Electrical Investments

Company or Board	Nom. Value	Middle price 28th May	Two Weeks' Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	26/9	−3d	70	50	9 7 0	39/3	23/-
I.C.I.	£1	45/3	−1/6	10	10	4 8 6	49/9	41/3
Intl. Combustion	5/-	20/6		25	20*	4 17 6	25/-	15/3
Johnson & Phillips	£1	40/9		15	15	7 7 3	46/6	37/6
Lancashire Dynamo	£1	45/-		15	11*	4 17 9	49/9	40/9
Laurence, Scott	5/-	15/9		12½	15	4 15 3	16/9	13/3
Lister, R. A.	£1	34/3		9·3	10	5 16 9	35/3	27/6
London Elec. Wire	£1	49/3	−2/-	12½	12½	5 1 6	52/9	46/6
Lucas, J.	£1	32/6	−1/3	7½	7½	4 12 3	40/3	31/3
Marryat & Scott	2/-	10/6		25	30	5 14 3	11/-	9/6
Mather & Platt	£1	58/6	−6d	13·4*	15	5 2 6	65/3	51/6
Metal Industries	£1	20/-	−2/6	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	47/6		10	12½	5 5 3	48/6	43/6
Morphy-Richards	4/-	21/3	−2/6	35	50	9 8 3	27/3	21/3
Murex	£1	68/-		15	20	5 17 9	70/3	60/-
Newman Ind.	2/-	2/6		10	10	8 0 0	2/9	2/1
Oldham & Son	1/-	2/6		17½	20	—	3/-	2/4
Parnall (Yate)	5/-	6/3	−3d	14	12	9 12 0	9/6	5/6
Parsons, C. A.	£1	85/-		10	10	2 7 0	85/-	61/6
Plessey	10/-	70/-	−6d	27½	30‡	4 7 0	87/6	56/-
Pye "A" Deferred	5/-	16/-	−2/-	20	12½*	3 18 3	21/3	14/-
Revo	10/-	11/3	+3d	9	9	8 0 0	11/9	8/3
Reyrolle	£1	105/-	−5/-	15	16½	3 2 0	110/-	81/-
Rheostatic	4/-	9/6	+1/-	18½	12‡	5 1 0	—	8/3
Richardsons Westgarth	5/-	16/-		16⅝	16⅝	5 4 3	17/-	13/9
Scottish Cables	4/-	17/9		27½	27½	6 4 0	17/9	15/9
Smith (England), S.	4/-	12/6	−9d	17½	17½	5 12 0	14/3	11/-
Southern Areas	£1	20/-x.d.	+9d	10	7½	7 10 0	28/9	20/-
Strand Elec.	5/-	7/9		17½	15*	9 13 6	8/6	7/3
Sturtevant	5/-	24/9	−6d	14·4†	15†	3 0 6†	31/3	24/9
Sun Elec.	£1	36/-		15	20	11 2 3	37/6	36/-
Switchgear & Cowans	5/-	14/9		20	25	8 9 5	17/-	14/6
Taylor Tunnicliff	5/-	11/9	−6d	15	15	6 7 9	14/-	11/3
T.C.C.	10/-	45/-	+2/6	25	25	5 11 0	45/-	40/6
T.C. & M.	£1	30/6		8½	8½	5 11 6	34/-	26/-
Telephone Mfg.	5/-	7/9	+3d	10	10*	6 9 0	8/6	6/3
Thorn Elec.	5/-	17/6	−1/3	20	15*	4 5 9	22/6	16/-
Thornycroft	£1	45/-x.d.		15	15*	6 13 3	49/9	41/3
Tube Investments	£1	63/9	−2/6	22½	14*‡	4 7 9	70/6	54/9
Vactric	5/-	13/9	−1/3	10	15*	—	15/-	11/6
Veritys	5/-	9/3	−6d	12½	12½	6 15 3	10/-	6/9
Walsall Conduits	4/-	13/-	−3d	70	70	—	13/6	10/9
Ward & Goldstone	5/-	36/3	−1/3	50	30*	4 2 9	38/3	29/-
Watford	2/-	6/6		25	25	7 13 9	7/6	6/6
Westinghouse Brake	£1	81/3		18	18	4 8 6	100/-	71/6
West, Allen	5/-	13/9x.d.		15	15	5 9 0	14/6	11/6
Wolf Electric	5/-	19/-		20	20	5 5 3	26/3	19/-
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	79		6	6	7 12 0	80	66
Ord.	100	50		3¾	3¾	7 10 0	54	45
Anglo-Portuguese	£1	23/6	+6d	8	8	6 16 3	23/6	20/3
Brit. Elec. Traction:								
Def. Ord. "A"	5/-	18/-	−1/-	50	22½*	6 5 0	20/-	15/6
Cable & Wireless:								
Ord.	5/-	10/6	−1/-	10	10	4 15 3	11/3	9/6
4% Loan	100	92		4	4	4 7 0	92½	88
Calcutta Trams	£1	23/-		6†	7½†	6 10 6†	26/3	23/-
Cape Elec. Trams	£1	18/3	+9d	5½	7½	8 4 6	20/3	18/-
Marconi Marine	£1	32/-	+6d	10	10	6 5 0	34/-	31/-
Oriental Tel. Ord.	1/-	75/6	−2/-	16	—	—	90/-	75/6
Telephone Rentals	5/-	11/-x.d.		12½	12½	5 13 9	11/9	9/9

B.I.C.C.

As already known from the preliminary statement, British Insulated Callender's Cables achieved a 60 per cent improvement last year in the group trading surplus, and are paying an ordinary dividend of 12½ per cent, against the previous 10 per cent dividend supplemented by a 2½ per cent tax-free distribution. In the full accounts now published the latest dividend is shown to be covered fully four times over by the net profit available after tax, and in the chairman's accompanying review the increase in earnings is credited in large part to benefits from the heavy capital expenditure of recent years. In 1955 the capital employed by the group in plant and equipment, stocks and other assets was increased by some £12 million, which was financed in almost equal parts by new capital and retained profits. With further essential expenditure ahead, the strain on cash resources continues. In this connection Mr. McFadzean emphasises the handicaps imposed upon progressive industry by his reference to the group's £4·8 million tax charge for the year. At 51s the shares pay 4·9 per cent on the money.

Cable Prospects

While the annual results of the principal cable manufacturing groups have shown that 1955 was a good year for the industry, more light is becoming available now on the further outlook. The chairman of B.I.C.C. sums up the prospect for his company with some caution in view of the cutting back of expenditure and activity already taking place in other spheres. He is unable to visualise a repetition of the uniformly favourable conditions of last year, but looks forward to satisfactory results and has every confidence in the long-term aspect. Another view of the outlook appears in the statement accompanying a new issue of stock by Johnson & Phillips. This refers to the highly competitive conditions under which business is now being transacted, and to a narrowing of profit margins, but the company expects to obtain its due share of orders and to continue to earn reasonable profits. The £1·8 million 5¾ per cent loan offered to this company's stockholders was fully subscribed, and dealings began on Monday of this week at a fractional premium on the issue price of 97.

REPORTS and DIVIDENDS

British Insulated Callender's Cables, Ltd.—The annual meeting will be held on 15th June in Liverpool. In his review of the past year, Mr. W. H. McFadzean (chairman and managing director) says that the increase in trading profit has been due to several favourable factors, but the two main reasons have been the increase of 36 per cent in sales and the benefits now being received from substantial capital expenditure over recent years at home and abroad. Referring to the issue made last October, Mr. McFadzean says that this leaves only £500,000 of authorised capital unissued, and a resolution will therefore be submitted at the annual meeting for an increase in the authorised capital to £22 million by the creation of 4,500,000 additional ordinary shares of £1 each so as to have greater authorised capital available for issue should the need arise. Further extensive plans for re-equipment and expansion of the manufacturing facilities at home and abroad have already been approved, amounting to some £5,000,000, whilst schemes involving further expenditure of over £7,500,000 are under consideration.

Sales during the year reached the record figure of £119 million; a considerable proportion of the increase is accounted for by the higher prices ruling for many of the raw materials and copper in particular, but there has also been a substantial increase in the physical volume of output. The great bulk of the turnover has been in established lines, but there has also been satisfactory progress in several relatively new fields, such as thermoplastic cables and mineral-insulated cable. With regard to railway electrification, contracts have already been placed with the company by the British Transport Commission for the survey of the first two sections of line under the 15-year modernisation plan.

Competition overseas during 1955 has been more intensive than ever, but nevertheless they have done business in 120 countries and achieved direct exports of £18 million, including a substantial amount to the dollar area.

Mr. McFadzean expresses the hope that the Government's policy of discouraging capital expenditure by industry will be reversed at the earliest possible moment, and says that whilst the B.I.C.C. group will always have full regard to Government policy, they feel they must go ahead with essential expenditure to the maximum of their available resources.

The chairman mentions some of the interesting orders received from Government departments, nationalised industries, shipbuilding and shipping companies and industry generally. They have supplied all the rubber- and paper-insulated cables with aluminium conductors and sheaths for the new Latchford works of the British Aluminium Co., and have been entrusted with a large share of the work for the 275 kW supergrid. In the submarine power cable field the cables for the British Columbia Electric Co. have been completed ahead of schedule and are now being loaded on a cable ship for transport to Vancouver and installation this summer. The New Zealand Government has awarded them the contract to investigate and report on the practicability of a submarine power cable across the Cook Strait. After dealing with some of the group's overseas activities and the fluctuations in the price of copper, the chairman refers to research and development, and says that during the year much thought has been given to the new irradiation laboratory which is expected to come into early operation. This new laboratory is equipped with a 2,000,000 V electron accelerator, which will ensure that the company takes a leading part in the new science of irradiation engineering. A new section has also been started in the laboratories to cover the field of control engineering. Mr. McFadzean refers to the steps being taken by the company to ensure an adequate supply of technical staff. With regard to the current year, results to date are good and they have a satisfactory order book for many of their products.

British Vacuum Cleaner & Engineering Co., Ltd.—In the course of his speech at the annual meeting on 24th May, Mr. J. J. Hambridge (chairman and joint managing director) said that despite the difficulties which followed the changed pattern of the national economy, they had maintained their revenues, which showed a slight improvement over the previous year. They had sought to counteract the worst effects of the changed trading conditions by additions to their range. With regard to the outlook, for the first six months of the current financial year they had been working under difficulties as a result of the further restrictions imposed by the Government on the domestic section of the electrical industry. During the earlier months of the year sales of vacuum cleaners and washing machines showed a serious reduction, but with the introduction of new models a sensitive improvement had recently been registered. Notwithstanding the decline in the domestic section their total turnover for the first six months was marginally in line with that of last year.

Laurence, Scott & Electromotors, Ltd.—The annual meeting was held on 23rd May, Mr. G. H. Wilson (chairman and managing director) presiding. In his statement which had been previously circulated, Mr. Wilson said that the company's progress was due to a substantially higher turnover, and all present indications were that the works would be fully extended for the current year and beyond. Referring to the export market, the chairman said that this market called for fixed prices and quick deliveries. It was not unusual, however, to find that the whole of the delivery time available had expired before they obtained delivery from their suppliers of raw material required for manufacturing the order. The most serious feature, however, was the fact that in many cases prices were totally uncompetitive. It must be emphasised that over half the cost of their product was in the purchase of materials and services, over which they had no control, so the stabilisation of prices by their suppliers was essential in their efforts to maintain their exports. Speaking of the company's activities in the shipbuilding world, the chairman said that in the ten years since the war, 2,200 ships of all types and sizes had been or were being equipped with electrical gear of their manufacture.

G. & J. Weir, Ltd.—The annual meeting will be held on 25th June. In the course of his circulated statement, the Hon. J. Kenneth Weir (chairman) says that the output of new work and repairs during the year under review created another record. A high proportion of the output was for export markets, deliveries to foreign shipbuilders in particular showing an improvement over 1954. During the year the executive board approved the final arrangement and layout of a new test and development shop, designed to enable the largest boiler feed pumps to be tested at full load, pressure and temperature. The chairman briefly reviews the progress of the subsidiaries. The constantly increasing size of the pumping units required for power stations, graving docks, etc., both at home and abroad necessitates extensions by Drysdale & Co., Ltd., involving heavier buildings and plant to meet these requirements and plans are well advanced and orders placed for dealing adequately with this side of the business.

The Harland Engineering Co., Ltd.—In his review of the company's activities for 1955, Mr. H. Cowan-Douglas (chairman) says that the more important events of the year were the opening of the new works at Timperley, Ches., and the starting-up of the new jointly owned South African manufacturing company, and but for the exceptional expenditure on these projects, the financial result for the year would have been very much the same as for the record year of 1954. The output of the Alloa works was slightly higher than for the previous year. Substantial capital expenditure has been authorised for works extensions, the most important being to the water turbine shop which will put them not only in the position of being able to manufacture turbines up to the largest sizes, but

also to provide facilities for the very heavy plant required in thermal and nuclear power development. The total value of orders secured during the year shows an increase of over 50 per cent compared with 1954, and despite intensified foreign competition they have succeeded in increasing their export order intake to the same extent.

To provide additional finance for capital expenditure a loan of £95,000 has been arranged from an insurance company and it is proposed to raise the balance by means of a rights issue to ordinary stockholders of one new ordinary share of 5s at 7s 6d per share for every three held.

The Power Securities Corporation, Ltd.—The annual meeting will be held on 13th June. In his circulated statement, Sir Andrew MacTaggart (chairman) says that Balfour, Beatty & Co., Ltd., the chief subsidiary, continue to expand, both at home and abroad. Progress on the Staythorpe power station, which they are constructing for the C.E.A., continues satisfactorily. For the first section, station "A," the sixth and last turbo-alternator set will be completed this year, and they are now in process of completing the design of the section to be known as station "B." At Carmarthen Bay station, five sets are now in commission and the sixth set is well under way. During the year they have erected approximately 520 miles of h.v. transmission lines and they still have in hand approximately 2,000 miles for the C.E.A. and the North of Scotland Hydro-Electric Board, together with some hundreds of miles of l.v. lines. These h.v. lines include nearly 500 miles of the 275 kV supergrid. Overseas they are handling a large volume of work in Kenya, Tanganyika, Malaya and Iraq.

The directors have come to the conclusion that further capital is required to cope with the expanding turnover, particularly in connection with overseas contracts, and they have therefore under consideration the issue of the 300,000 undenominated shares as ordinary shares. Application has been made to the Capital Issues Committee for consent to the issue, and subject to this being granted, it is proposed that these shares be offered to shareholders in the proportion of one new share for every four held. The price will depend on market conditions at the date of the issue. To provide for further requirements it will be proposed at the annual meeting that the authorised capital be increased to £2,500,000 by the creation of 500,000 unclassified shares of £1 each.

The Pulsometer Engineering Co., Ltd.—Mr. J. Dalgleish (chairman) presided at the annual meeting held on 23rd May. In his statement circulated to shareholders, the chairman said that turnover expanded once again to a new record. Referring to the existing arrangement with Pacific Pumps, Inc., of California, to manufacture a limited range of Pacific pumps, he said that a new agreement had been concluded to manufacture the complete range of Pacific pumps during the next ten years. Application was being submitted to the London Stock Exchange Council for permission deal in Pulsometer shares on the Stock Exchange.

Hopkinsons, Ltd.—Mr. R. L. Brown (chairman) presided at the annual meeting held on 24th May. In the course of his circulated statement, the chairman said that whilst the profit for the year under review was slightly less than for the previous year, this was largely due to rising costs of materials, wages, fuel, power and freight as against their efforts to stabilise prices, which had resulted in a somewhat lower ratio of profit. They had recently been awarded the contract for the boiler mountings and valves for the High Marnham station of the Central Electricity Authority.

W. H. Allen, Sons & Co., Ltd., is making an issue of £800,000 5¾ per cent first mortgage debenture stock to the Prudential Assurance Co., at 98 per cent. The money is being raised to finance a development programme. A one-for-one scrip issue was recently announced which will capitalise £321,875 from the £717,200 in reserve for increased cost of replacement of fixed assets and for research, and £700,000 from the general reserve. The scrip issue will be made to holders at 24th May.

Sturtevant Engineering Co., Ltd.—The annual meeting was held on 23rd May, Mr. G. R. Thursfield (chairman) presiding. In his statement, Mr. Thursfield said that although they had been working to full capacity throughout the year, there had been a slight falling off in orders during the last few months which was mainly attributable to the credit squeeze which had caused many of their customers to defer or cancel projects in which Sturtevant equipment had been incorporated. In spite of these setbacks, they still had a fairly satisfactory order book, which would keep them fully occupied for some time.

Superheater Co., Ltd.—In his circulated statement presented to the annual meeting held on 24th May, Sir Alexander McColl (chairman) said that there was further progress in the volume of orders received. The Locomotive Division received in the past year orders of record value; in the current year it was already evident that in the Power Plant Division a record volume was assured.

Newman Industries, Ltd.—The annual meeting was held on 25th May, Mr. E. Cassleton Elliott presiding in the absence abroad of the chairman.

In his circulated statement, the chairman said that the manufacture of rotating electrical equipment at Yate now covered, or would shortly cover, a wide range of products in the electric motor field, including standard motors from 1 h.p. to 500 h.p. and fractional h.p. motors. In the export field regular shipments were made to some 50 countries and the Board of Trade returns for 1955 showed that most of the industrial type electric motors from Great Britain to the United States were of Newman manufacture. Since the last report the company's activities had been extended to the electronics field.

Johnson & Phillips, Ltd.—The issue of £1,800,000 5¾ per cent unsecured loan stock, 1971-76, was oversubscribed.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates do not clash with others already arranged

Monday, 4th June

LEEDS.—Great Northern Hotel, 7 p.m. A.S.E.E. Leeds Branch. Annual general meeting.

LONDON.—St. Ermin's Hotel, Westminster, S.W.1. Association of Electrical Machinery Trades. Annual general meeting, preceded at 12.45 for 1 p.m. by a luncheon.

SHEFFIELD.—Royal Victoria Hotel, 7.30 p.m. A.S.E.E. Sheffield Branch. Annual general meeting.

Tuesday, 5th June

CARDIFF.—Angel Hotel, Westgate Street, 7 p.m. A.S.E.E. South Wales Branch. Annual general meeting.

ELTHAM.—Congregational Church Hall, Court Road, 7.15 p.m. A.S.E.E. North-East London Branch. Annual general meeting.

LONDON.—Great George Street, S.W.1, 5.30 p.m. Institution of Civil Engineers. Annual general meeting.

Wednesday, 6th June

MANCHESTER.—Engineers' Club, 7 p.m. A.S.E.E. Manchester Branch. Annual meeting.

NOTTINGHAM.—E.M.B. Showroom Theatre, Smithy Row, 7.30 p.m. A.S.E.E. Nottingham Branch. Annual general meeting.

PRESTON.—49a, Fishergate, 7.30 p.m. A.S.E.E. Preston Branch. Annual general meeting.

Thursday, 7th June

CROYDON.—Half Moon Hotel, Broad Green, 7.15 p.m. A.S.E.E. South London Branch. Annual general meeting.

Friday, 8th June

BRISTOL.—Grand Hotel, 7.30 p.m. A.S.E.E. Bristol & West of England Branch. Annual general meeting.

FAWLEY.—I.E.E. Southern Centre. Summer visit to the Esso Refinery and tour in New Forest.

LONDON.—Café Royal, W.1. Cromptonian Association. Annual dinner and reunion.

Saturday, 9th June

LONDON.—Junior Institution of Engineers. Summer excursion to Woodbridge.

Electricity in the Tropics

THREE-DAY INTERNATIONAL SYMPOSIUM IN PARIS

AN international symposium on electricity in the tropics was held in Paris on 28th to 30th May under the chairmanship of Mr. A. Antoine (Electricité de France) with Messrs. V. A. H. Clements (Central Electricity Authority) and C. Wittmann (Belgium) as deputy chairmen. Two committees' reports and 29 individual papers were discussed at four sessions.

The opening session was allocated to the report of the committee on materials (chairman, Mr. H. Astbury, British Electrical and Allied Manufacturers' Association), which first described the various climatic factors and their effects. Those common to all regions, more or less, were stated as maximum and minimum monthly temperatures, atmospheric humidity and fungi. Other factors, localised or not affecting certain materials, were exemplified by insects, salt in the air, sun's rays and dust.

In virgin forests and well wooded areas, air temperatures during wet seasons hardly exceeded 35 deg and affected materials only because of the combination of heat and humidity. On plains and during dry seasons in woods air temperatures towards noon might reach 45 to 50 deg C and surfaces exposed to the sun's rays could be 30 to 40 deg above shade temperature. Rapid variations of temperature were also important. On winter nights in open country it might fall from 40 to – 10 deg C. Mechanically, high temperatures affected impregnated products by permitting ingress of moisture and causing surface cracks by expansion and contraction and oxidation, besides intensifying the influence of other adverse factors. In its electrical aspect, the life of insulation deteriorated by half for each 8 to 10 deg C above the desired temperature.

Humidity appeared to be the most harmful factor in reducing durability of materials. Its relative value in virgin forests and in the rainy season elsewhere might rise to 80 per cent by day and more at night, reaching saturation at dawn and falling to 65 per cent at noon, coinciding with temperatures of 25 to 35 deg C. In dry seasons on plains extreme values might be between 2 and 20 per cent. The general conclusion was that it would be premature to propose any general solution to a problem which offered so many variables. Three of the twelve individual papers on materials had British authors: Messrs. F. I. Martin (B.T.H. Co.) on insulation; Dr. F. A. Chapman (British Aluminium Co.) on protection against corrosion; and the Shell Petroleum Co. on packing for transport and storage.

Power Supply

Three reports by the second committee (chairman, Mr. C. Wittmann) occupied the remaining sessions. The first dealt with general principles of power supply, whether from small local plants or transmitted at high voltage from hydro or steam stations. There were only two supporting papers. One related to costs of diesel operation in French colonies with different prices of fuel oil; the other was a study, by Balfour, Beatty & Co., of methods of quickly evaluating by graphs the economies of transmitting different amounts of power for varying distances at 3·3 to 66 kV as against local diesel generation at differing prices of oil. Transmission capacity of the lines was limited for short distances by conductor temperature rise (not to exceed 30 deg C above an ambient of 20 deg) and for longer distances by voltage drop (not to exceed 20 per cent). Overhead lines of steel-cored aluminium were assumed to be run on impregnated timber supports; guard wires and steel supports would increase costs by 20 per cent. Prices of transformers and other components were included to give overall figures per kW-mile, allowing total annual charges of 15 per cent and assuming an annual load factor of 30 per cent. For diesels annual charges were taken at 13 per cent.

Plant Operation

Report No. 2 covered plant operation, with special reference to diesels of 100 to 200 kW, between 200 and 1,000 kW and above 1,000 kW. References were also made to the prospects of hydro, steam and gas turbines and nuclear fission. Of the last-named, it was suggested that reactors to give an electrical output of about 2,000 kW were required, the components of which could be transported by aeroplane. Only one of the five papers submitted (by Mr. E. W. Golding, Electrical Research Association) dealt with the utilisation of such unconventional means of power production as wind, solar heat, or animal and vegetable waste locally available, either alone or as supplementary to more usual fuels, which would be costly to transport to mainly agricultural areas.

Transmission Systems

Transmission was covered in a third report based upon details given in seven papers. Three described different aspects of the 220, 110 and 50 kV systems of the Haut-Katanga (Belgian Congo) scheme and one the construction of lines in Senegal (French). British papers gave particulars of the construction and operation of the 66 kV network in Northern Rhodesia (Messrs. R. H. Arnot and C. H. Black) and of experience gained in Uganda (Messrs. W. D. D. Fenton and J. M. Stock). The special aspect of lightning protection was dealt with by Mr. R. H. Golde.

The report showed conditions in Northern Rhodesia and Haut-Katanga to be similar in many respects, having the same cycle of seasons, viz. a dry period from April to October, in which the shade temperature varied from 0 to 30 deg C, and a rainy season when the range was from 18 to 35 deg. Lightning constituted the greatest hazard. During the latter six months violent storms were frequent and lightning strokes averaged 120 to 150 in the two districts, respectively, compared with 30 in Europe over the whole year.

Conductors in both regions were of copper in view of the existence of the copper mines. The Belgian engineers preferred copper not only because it was cheaper than aluminium in the circumstances but also because of its better resistance to corrosion and its lower corona losses. Earth wires, formerly of galvanised steel in industrial areas, had been replaced by copperweld. In Haut-Katanga wood poles had been found vulnerable to attacks by termites, but in Northern Rhodesia the life of creosote-impregnated wood supports was expected to be about 25 years.

In Uganda, where the supply at 132 kV transmission was from the Owen Falls hydro-electric plant (*Electrical Review*, 15th May, 1954), geographical and climatic conditions were said to be generally similar to those of Haut-Katanga in that the altitude was from 900 to 1,200 metres,

termites were troublesome, rapid growth of vegetation necessitated periodic clearing of line route and thunderstorms were frequent. The effects of lightning were expected to be much less serious on the 132 kV lines. The climate in Uganda was more temperate in spite of its being nearer the equator, so that undue corrosion need not be feared and the use of ordinary materials was facilitated.

Since transmission of heavy power loads for very long distances to industrial centres was not an outstanding feature of Uganda, voltages were similar to those of England, viz. 132, 66, 33 and 11 kV. Wood supports for copper conductors were employed for the two lowest voltages and metal pylons with steel-cored aluminium conductors for the two highest.

In his study of the protection of high-voltage systems against lightning in the tropics, Mr. Golde considered general principles necessary for guarding against damage to overhead lines, supports and substations which could be adapted to different circumstances. Indirect strokes presented no danger to lines over 30 kV. Risk of damage from direct strokes could be greatly reduced by installing two guard wires provided the vertical angle made with the conductor did not exceed 30 deg.

After summarising methods of limiting interruptions of supply, the author dealt with protection of substation equipment in detail. The conclusion was reached that the protection of networks in regions subject to storms ought to be dealt with as complete entities that covered production, transformation and transmission. Appreciable economies would be obtained by varying the means adopted for long lines in relation to the diverse characteristics of the regions traversed, especially in regard to soil resistivity.

The final session was allocated to distribution and interior installations concerning which four papers described practice in French overseas territories. Consumers in most areas were said to be too dispersed and to use too little electricity for economic adoption of normal European standards of construction and of continuity of supply and cyclones left some districts without electricity for several days. The tendency was to raise voltages from 220-127 to 380-220, but few motors were used and single-phase supplies were usually given.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Copper versus Aluminium

REFERRING to the correspondence on this subject in the *Electrical Review* of 4th May, Mr. S. F. Rice has obviously done a good turn for producers of aluminium conductors for overhead lines and is rather suggesting, in our opinion, that this is the most sensible outlet for the competitive use of aluminium in the place of copper.

Mr. Rice has, however, not reckoned with the prowess of the industry and the need for the production of other forms of electrical conductors which are so necessary to stabilise the position in the market and take away the grip that is at present held on supplies of copper by some producers. The genius of the cable makers will soon be shown in new types of aluminium conductor cables for general wiring and for underground purposes, which will give the engineer the attraction and necessary stabilising factor to keep copper where it has now been forced.

We trust that all progressively minded engineers and the appropriate bodies will give full support to the expansion of the use of aluminium in all forms, and so enable us to keep out of the hands of the Philistines.

London, S.W.18. W. L. WRAY,
General Manager,
Wandleside Cable Works, Ltd.

Capital for Nationalised Industries

IN his letter in your issue of 25th May " Statist " is correct in saying that the purpose of my calculations was not to give absolute values but to compare the degree of capitalisation of the three types of industry. For this I had to use the figures for net capital investment because only these were available in a comparable form for all three industries. This net investment was defined as actual (i.e. historical) first cost of fixed assets, less depreciation, plus net current assets. At the other extreme, if one takes present-day first cost and no depreciation, the ratio of capital to turnover is some twice as great, as " Statist " points out.

Whichever basis is used the conclusion is the same, namely, that electricity supply is more heavily capitalised than most other services and far more so than almost any manufacturing industry, and the proportion of this capital that can be equitably provided out of revenue is correspondingly small.

London, N.W. D. J. BOLTON.

Street Lighting

IN your report of the Illuminating Engineers' Summer Meeting we note that in the paper presented by Messrs. Ferguson and Stevens it is stated " the authors said it appeared that a majority of road users preferred sodium street lighting to high-pressure mercury, but it was not easy to decide why such a preference was expressed."

We feel there is no mystery about such a preference. The visual acuity of the human eye is at its peak with yellow and is very low with blue.

Blackburn. R. WHITTAKER,
Director,
Gordon Wilson (Wholesale Electric), Ltd.

World Power Conference

THE annual report of the World Power Conference for 1955 is now available from the secretary, Mr. C. H. Gray, Central Office, 201-202, Grand Buildings, Trafalgar Square, London, W.C.2. The number of member countries is stated to be 47, four more having been admitted during the year.

Advance particulars of the fifth plenary meeting, which opens on 17th June, are given. The next plenary meeting after this year's is to be held in Australia in 1962, but interim sectional meetings will take place in Yugoslavia (1957), Canada (1958) and Switzerland (1960).

Relations with other international organisations are briefly summarised. Income of the International Executive Council was £4,035 and expenditure £3,700. The president of the World Power Conference is Sir Harold Hartley. The chairman of the International Executive Council is Sir Vincent de Ferranti and the vice-chairmen are Dr. A. J. Alves de Souza (Brazil), Mr. Gail A. Hathaway (U.S.A.) and Dr. Franz Holzinger (Austria). A new issue of the W.P.C. Statistical Year Book is expected to be ready shortly.

Lock-Wound Core

A Significant Advance in Transformer Manufacture

By R. J. GRESLEY, A.M.I.E.E.*

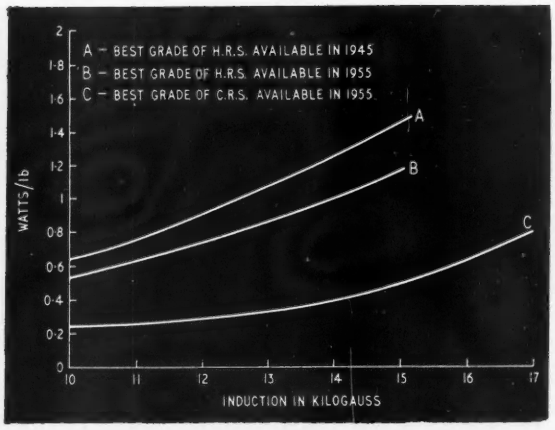

A – BEST GRADE OF H.R.S. AVAILABLE IN 1945
B – BEST GRADE OF H.R.S. AVAILABLE IN 1955
C – BEST GRADE OF C.R.S. AVAILABLE IN 1955
WATTS/lb
INDUCTION IN KILOGAUSS

Fig. 1.—Specific loss of h.r. and c.r. steel

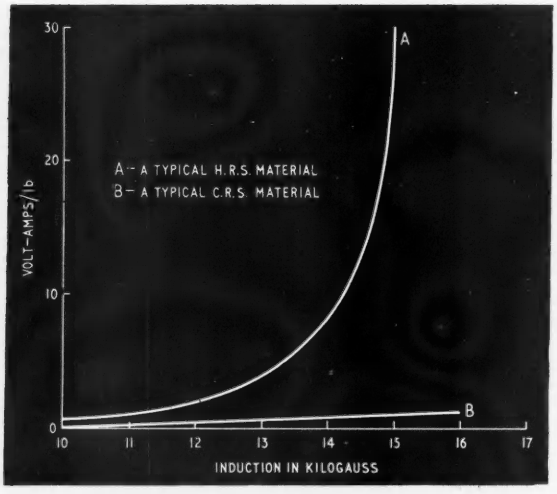


Fig. 2.—Magnetising VA of h.r. and c.r. steel

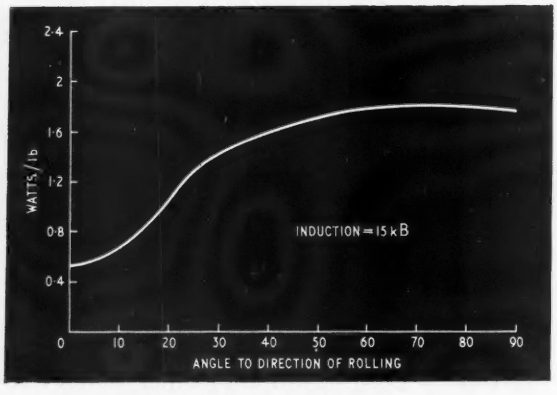


Fig. 3.—Specific loss in cold reduced steel

IN the last few years cold reduced grain-oriented electrical steels have become generally available in Great Britain as a result of a new technique in electrical steel manufacture. This type of material is referred to as "oriented" because the crystal lattices have been so arranged that their axes of easiest magnetisation are nearly parallel and aligned in the direction of rolling. This has been achieved by a combination of highly controlled analysis, and special cold rolling and annealing procedures. The result is a steel which has a considerably lower specific loss, in the direction of rolling, than hot rolled steels, as shown in Fig. 1, and a corresponding improvement in magnetisation current as shown in Fig. 2.

The improvement in magnetising current is particularly important as it will be seen that at inductions of 15 to 16 kilogauss the magnetising current does not show a tendency to increase rapidly as in the case of hot rolled steels. As a result, it is feasible to use cold reduced steels at inductions of 15 kilogauss and above.

To realise the best performance from cold reduced steel it is essential for the direction of the flux to lie mainly along the direction of rolling, which may be referred to as the preferential magnetising line. When the flux has to cross this line, the specific loss and specific magnetising current are very considerably increased. This is shown in Fig. 3 for the specific loss, from which it will be seen that if the flux is at right angles to the preferred line the specific loss is increased by approximately 200 per cent and practically the same increase is obtained when the flux is at 45 deg to the preferred line.

In a conventional stacked core a considerable portion of the flux runs transversely to the preferred direction, thereby causing increased losses and magnetising currents. This is shown in Fig. 4 which illustrates a single-phase transformer of the two-coil type and it will be seen that there are four portions of the core where the flux does not run parallel to the preferred direction.

In addition, joints are possible areas of increased loss,

* Ferranti, Ltd.

Fig. 4.—Flux path in a two-coil single-phase transformer

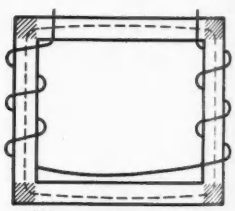


Fig. 5.—A single lamination

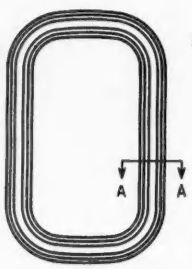
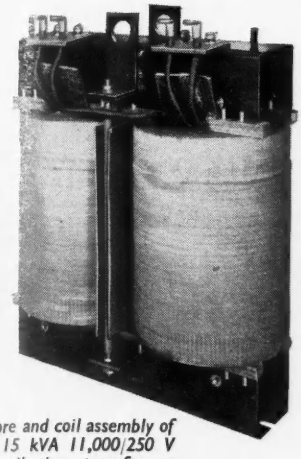
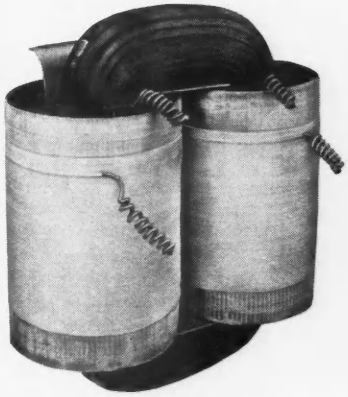


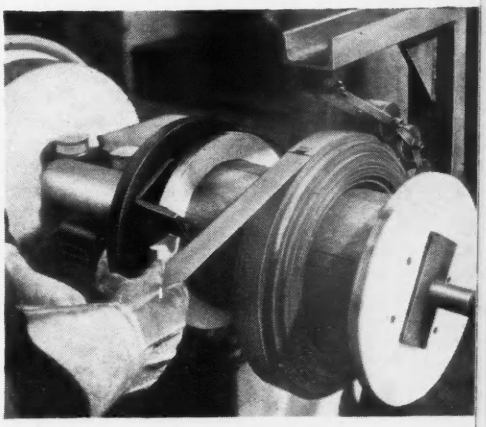
Fig. 6.—Shape of the finished core



Core and coil assembly of a 15 kVA 11,000/250 V distribution transformer

Core and windings of a lock-wound core distribution transformer





Winding the core on a mandrel for a lock-wound core distribution transformer

especially where there is not absolute butting of the laminations. In the conventional stacked core there must, from the nature of the core, be a considerable number of such joints.

For these reasons the stacked type of core is not as efficient when made of cold reduced steels as it is when made from hot rolled steels and, in fact, the increase in loss per unit weight in cold reduced cores is some 50 per cent over the specific loss measured on Lloyd-Fisher or Epstein square samples, whereas in hot rolled steels it is only 10-15 per cent.

In the evolution of new types of core for manufacture from cold reduced steels close attention must be paid to directing the flux along the preferred line of magnetisation and to a reduction of the number of joints to a minimum. The type of core described in this article has been developed by Ferranti, Ltd., to meet these requirements, and it is now in production for single-phase transformers up to 25 kVA.

In this core each lamination consists of a length of core steel which has a slot at one end and a tongue at the other, as shown in Fig. 5. The laminations may be cut from steel in either continuous coil or standard sheet form, but in either case the steel must have a heat resistant insulating coating capable of withstanding the temperatures of the subsequent stress relief annealing process.

The core is wound in circular form under tension on a collapsible mandrel of a predetermined diameter, each lamination being locked on to the preceding one by the tongue and slot. Different widths of laminations are used so as to produce a core with a stepped cross-section approximating to a circle. The laminations are of such length as to encompass about two turns of the winding mandrel but the exact length is not critical provided that it does not cause building up in places due to coincidence of the joints.

After completion of the winding, the core is held in position with a steel band, the winding mandrel removed and the core shaped hydraulically to the required rectangular window shape. This shape approximates to the window of a conventional core but with radiused corners as shown in Fig. 6. Special clamps are then fitted and the core is subjected to a high temperature anneal in a reducing atmosphere. This annealing treatment is necessary to relieve the stresses set up in the material during the previous winding and shaping operations, and to permanently set the core in the required final shape.

After annealing the core is dismantled into its component laminations. The laminations are then laced through the coils, each lamination being hooked on to the preceding one until the complete core has been re-assembled within the coils.

Care must be taken during these operations to avoid roughly handling or bending the laminations out of shape. When re-assembly is complete the core is again banded and is then firmly fixed in position relative to the coils by insulating strips. The core and coil assembly is fitted with steel clamps so designed that whilst adequately securing the core and coil assembly they do not in any way impose stresses on the core laminations.

In this type of core the joint produced when one lamination is hooked on the preceding one is a lapped joint of generous proportions and this reduces the extra loss and increase of magnetising current caused by joints. This is further improved by the small number of joints in this type of core; for example, the 1,000 joints in a conventional 15 kVA 11 kV transformer core are replaced by 146 joints in the lock-wound design.

Although this core is considerably different from the conventional it necessitates only slight alterations to the windings used with conventional cores. As a result the thermal and insulation characteristics of the transformers are identical with those having conventional cores.

The lock-wound core is particularly suitable for a highly mechanised production line. The laminations are readily manufactured from strip, cutting and slotting being achieved in one operation. Automatic feeding of the strip is desirable and economical, since the reduced number of sizes of laminations permits large batch production. Winding of the core is a speedy operation, and unit annealing simplifies handling and furnace loading. Coil winding is conventional, and core relacing is a simple and rapid

Comparison Between Conventional and Lock-Wound Cores

	5 kVA		15 kVA	
	Conventional	Lock-wound	Conventional	Lock-wound
Wt. of core—lb	68	63	114	108
Iron loss—watts	35	26	70	55
Mag. volt-amps ...	150	37	150	28
No. of joints ...	860	100	1,000	146

operation, the coils being held in a specially designed jig. The inherently strong construction of the core simplifies the clamping design, resulting in a simple rugged transformer with good electrical and mechanical properties.

The superior magnetic properties of the lock-wound core over the conventional stacked core result in iron losses being reduced by 20 to 25 per cent when cores of the same grade of cold reduced steel are compared. A comparison between cores for 5 and 15 kVA units is given in the table (p. 947), the coils, etc., being identical, and the cores being of the same cross-section. Such reductions in iron loss are important in small single-phase units used mainly for rural electrification, where reduced iron losses are essential owing to the low load factor and small revenue to be expected.

"Open Day" at National Physical Laboratory

AN interesting new exhibit seen at the National Physical Laboratory last Friday was the caesium resonator developed as the only atomic standard of time and frequency yet in use in the world. This provides a unit of time accurate to three parts in ten thousand million and is based on the natural resonant frequency of the caesium atom. A radio oscillator in the laboratory is set precisely at this frequency and then used to calibrate the quartz clock which acts as a working standard of time and frequency. The atomic frequency is a fundamental constant and is not influenced by such things as temperature, pressure and mechanical vibration. Nor can it be influenced by geophysical features such as the movements of air masses which are believed to affect the rate of rotation of the earth and therefore the astronomical second.

In the electrical section a new million volt 700 kVA transformer is being installed to replace the bank of three cascaded air-insulated transformers which, after nearly 30 years' useful service, are no longer able to provide an adequate voltage for test purposes. The new unit will be a single oil-immersed transformer with the tank and core at half the output voltage, the tank being supported on six columns built up from porcelain post insulators. The transformer will be located outside the laboratory on the north side of the building and a porcelain wall bushing for one million volts will be provided to bring the supply into the laboratory when required. The complete installation should be functioning for test purposes in the autumn.

In the Control Mechanisms and Electronics Division the work of development and construction on the new high-speed automatic computing engine (ACE) is nearly half completed. The design of this is based on the experience gained from the experimental ACE pilot model but it is a much more powerful computing tool by virtue of increased speed, larger storage capacity, etc. Its overall speed will be at least four times that of the DEUCE computer. The mercury delay lines and magnetic drums will store a total of 1½ million binary digits and this will allow the solution of complex problems which have hitherto been beyond the capabilities of existing computing machines.

An investigation into the life of electric lamps used as standard sources of light has shown that where d.c. is used, the polarity has a considerable effect and the lamp life can be prolonged by reversals of polarity at intervals of, say, ten minutes.

The annual report of the National Physical Laboratory for 1955 has just been published and records the start of work on the site of the new Ship Hydro-Dynamics Laboratory at Feltham. The main tank sections should be completed by next winter and this will be 1,300ft long by 48ft wide by 28ft deep. The carriage to be provided will have a maximum speed of 50ft per second.

Electrical Installation Inspection

THE Board of Trade has intimated that it has approved the formation of the National Inspection Council for Electrical Installation Contracting, subject to the final clearance of the Memorandum and Articles of Association by its legal advisers. It is anticipated that the licence will be issued within the course of the next two or three weeks, and in the meantime active steps have been taken to initiate the organisation of the National Inspection Council.

Mr. P. V. Hunter, C.B.E., has been elected the first chairman of the Council and Mr. C. R. King, C.B.E., deputy chairman. The National Inspection Board will be the executive body responsible for the operations of the Council and the members with the bodies who have nominated them are as follows:—Institution of Electrical Engineers, Mr. P. V. Hunter, Mr. Forbes Jackson; Central Electricity Authority, Sir Henry Self; Area Electricity Boards, Mr. T. E. Daniel, Mr. C. R. King, Mr. C. T. Melling; South of Scotland Electricity Board, Mr. J. Gogan; Electrical Contractors Association (Inc.), Mr. J. G. Briggs, Mr. A. F. Plummer, Mr. L. C. Penwill; Electrical Contractors Association of Scotland, Mr. J. D. D. Shaw; Royal Institute of British Architects, Mr. Thomas Mitchell; Association of Consulting Engineers, Mr. T. B. Rolls; Electrical Power Engineers' Association, Mr. W. E. Fry; Electrical Trades Union, Mr. L. J. Gregory; Association of Supervising Electrical Engineers, Mr. E. J. Sutton.

Mr. W. G. S. Thompson, O.B.E., who is relinquishing his post as assistant secretary, general administration, Central Electricity Authority, has been appointed chief executive and secretary.

The offices of the Council will be at 13, Victoria Street, S.W.1 (telephone: Abbey 3132), and will be open from 4th June.

European Railway Scheme

AGREEMENT has been reached for the electrification of the railway lines which connect the big German railway marshalling yard at Ehrang, north of Trier, with the industrial basins of Lorraine and Luxembourg, via Apach and Thionville, and via Wasserbilig, Bettembourg and Rodange.

This electrification project is the result of the work of a committee, set up two years ago by the general managers of the railways of France, Luxembourg, the Saar, Germany and Belgium, to investigate the movement of traffics in which the industries of the European Coal and Steel Community are interested, in the vicinity of the frontiers common to these five countries.

The electrification of the line between Ehrang and Coblence, which will make it possible to link up with the Rhine lines now being electrified, will be considered later when the German Railways are of the opinion that such a step is economically justified within the framework of their general plan of modernisation.

It has been decided to adopt the 25 kV, single-phase, industrial frequency system which is already in use in the north-east of France.

The capital cost of the equipment of the fixed installations is estimated to be approximately 600 million Belgian francs and the estimated annual savings in working costs will be in the neighbourhood of 70 million Belgian francs per annum.

OVERSEAS ELECTRICAL TRADE

Increased Exports of Heavy Equipment

ALTHOUGH there were fewer working days in April than in the preceding month, British electrical exports continued to rise and the value for the month of £18,173,589 was over a million pounds better than the March total, and compares with £16·8 million for April, 1955. The aggregate for the first four months of £71,177,066 shows an advance of over £6 million compared with the corresponding period of 1955. The month's improvement is largely accounted for by increased shipments of heavy electrical equipment.

It will be seen from Table I that exports of generating plant and motors amounted to £3,064,498, nearly £600,000 more than in March, though for the four months the total of £11·4 million was still below that for the corresponding period of 1955 (£12·2 million). Australia was once again the principal purchaser with a value of £417,938, India being second with £251,400 and South Africa (£242,216) third. Outside the Commonwealth, Spain was the most important market, taking equipment valued at £218,506. Exports of converting machinery, mercury-arc rectifiers, transformers, switchgear, etc., at £3,028,143 were nearly £500,000 higher than for March, the leading purchasing countries being India (£435,489), Australia (£415,793) and South Africa

TABLE I.—ELECTRICAL EXPORTS

Class	April, 1956	Four months ended April, 1955	Four months ended April, 1956
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	139,213	523,258	506,689
Ditto, 10 to 65 kW	110,529	558,905	447,282
Ditto, 65 to 200 kW	214,677	447,431	576,234
Ditto, over 200 kW	349,942	2,016,696	1,283,447
Spark ignition engine driven	49,991	99,904	177,551
Steam turbine driven	33,378	581,541	127,581
Hydraulic turbine driven	93,743	172,417	145,529
Other prime mover driven	222,714	148,329	319,446
Generators, not exceeding 200 kW	74,113	546,935	481,885
Ditto, over 200 kW	77,560	568,214	381,567
Parts of generators	522,142	2,074,906	2,314,351
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ¼ h.p.	249,075	951,303	827,589
Over ¼ but under 1 h.p.	62,295	281,513	239,955
1 h.p. to 250 h.p.	408,290	1,560,236	1,721,754
Over 250 h.p.	99,716	340,293	273,086
Railway, tramway and trolley-bus motors complete and parts of all motors	130,842	560,091	661,341
Motor starting and controlling gear	226,278	826,721	938,707
	3,064,498	12,258,693	11,423,994
Converting machinery	24,125	212,569	125,930
Mercury-arc rectifiers	76,824	273,630	286,387
Transformers for lighting, heating and power (incl. coils)	1,446,038	3,861,138	4,561,014
Switchgear and switchboards (not telegraph or telephone), up to 200 A and 660 V	261,344	1,231,822	992,361
Ditto, other	1,219,812	4,306,635	4,696,445
	3,028,143	9,885,794	10,662,137
Primary batteries:			
Lighting	77,809	296,224	328,460
Radio	210,774	668,496	927,596
Other	42,109	161,036	179,665
Parts (excl. carbons)	26,290	131,194	154,383
Lamps:			
Filament, exceeding 24 V	100,008	387,982	404,988
Ditto, under 24 V	27,779	128,139	122,763
Arc lamps and searchlights	17,915	52,023	78,010
Discharge lamps, fluorescent tubes, etc.	59,968	288,880	283,549
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury arc rectifiers), photo-electric cells, stabilizing and cold cathode valves, magnetrons, klystrons	33,579	109,328	104,323
Cathode-ray tubes	20,248	39,484	65,273
Other valves (not X-ray)	198,026	692,351	735,942
Parts (excluding glass bulbs)	6,720	73,027	59,836
Radio and television transmitters	8,440	228,182	221,149
Commercial radio and radar equipment	1,141,857	3,996,247	4,558,245
Domestic radio receivers, mains	135,860	722,382	624,351
Ditto, battery	85,790	256,362	320,734
Ditto, other (incl. car)	17,563	87,118	104,203
Radiograms	41,846	208,871	147,625
Television sets	25,790	35,550	165,203
Public address equipment	98,467	307,269	362,922
Sound reproducing app., n.e.s.	28,279	101,785	135,467
Components and parts, n.e.s.	668,043	2,285,016	2,622,361
	2,510,508	9,142,972	10,227,634
Telegraph and telephone installations	700,551	2,992,164	2,539,353
Telephone instruments, separately consigned	126,532	295,563	474,865
Telegraph and telephone parts	475,891	1,981,027	2,185,287
Line apparatus for long distance commun.	195,433	331,764	539,447
	1,498,407	5,600,518	5,738,952

Class	April, 1956	Four months ended April, 1955	Four months ended April, 1956
	£	£	£
Cookers	82,735	635,467	353,762
Toasters	12,530	124,119	78,275
Other cooking apparatus	34,759	132,907	145,071
Parts and accessories	98,695	259,272	350,904
Space heating appliances	41,560	183,504	199,112
Water heating appliances	39,230	123,911	138,264
Other heating appliances	44,661	131,868	161,989
Parts and accessories	64,557	268,321	261,737
Irons	94,694	453,250	435,837
Arc welding equipment, a.c.	55,661	140,152	238,038
Ditto, d.c.	63,100	136,928	190,258
Resistance welding equipment	33,112	99,724	92,598
Electric furnace plant	59,351	162,259	228,885
Magnetos, ignition	15,327	64,222	105,157
Sparking plugs	133,300	633,097	603,886
Elec. appliances for aeroplanes, n.e.s.	221,532	794,043	775,915
Ditto, for motor vehicles, n.e.s.	342,515	1,190,183	1,397,943
Ditto, for cycles, n.e.s.	71,866	308,914	317,218
Signalling app. (incl. traffic signals)	34,286	183,886	207,906
Industrial radio-frequency equipment	8,020	60,410	40,923
Bell app. (not telegraphic or telephonic)	7,288	34,874	35,422
Instruments, commercial	177,958	596,166	706,349
House service meters (including parts)	178,754	515,569	719,685
Electro-medical apparatus (not X-ray)	47,062	176,837	249,901
X-ray apparatus (excl. tubes and valves)	52,914	232,876	259,386
Vacuum tubes	26,931	93,298	100,219
Ceiling fans, complete	116,447	403,214	418,180
Desk fans, complete and parts of desk and ceiling fans	38,147	128,629	118,394
Vacuum cleaners	98,632	583,885	495,071
Floor polishers	87,375	346,954	344,367
Food mixers	66,227	193,361	251,698
Hair clippers and dry shavers	44,481	318,512	314,533
Other portable appliances	33,059	215,260	120,931
Parts	111,365	290,655	477,705
Portable elec. tools (not saws) and parts	230,007	773,595	807,453
Cables and wires:			
Telegraph and telephone, submarine	87,372	446,908	190,689
Ditto, other	845,749	1,972,349	3,233,865
Cotton, silk or art. silk insulated	58,266	198,181	257,465
Enamel, glass or asbestos insulated	106,366	324,317	338,890
Paper insulated	887,230	2,575,388	4,070,668
Rubber insulated	461,119	2,009,839	1,997,206
Thermoplastic insulated	148,319	286,487	532,600
Other	242,355	743,069	934,070
	2,836,776	8,556,538	11,555,453
Accumulators for motor vehicles	177,779	595,944	739,669
Ditto, traction	27,851	63,514	97,856
Ditto, radio and other portable	82,524	231,705	332,499
Ditto, other	69,566	94,308	237,779
Parts and accessories	82,215	366,966	339,887
Elec. porcelain, etc. (incl. insulators)	111,259	362,287	417,352
Insulating cloth and tape	49,234	254,879	250,434
Other insulating material	91,755	381,269	382,539
Permanent magnets	39,771	193,993	170,602
Radio, telegraph and telephone testing equipment, n.e.s.	49,506	159,594	140,826
Scientific elec. instruments (not telegraphic or telephonic):			
Time recorders and time switches, complete	16,544	132,235	53,902
Other	193,148	878,482	784,600
Electrical machinery, n.e.s.	94,056	320,231	452,191
Electrical apparatus and appliances, n.e.s.	719,259	2,356,063	2,946,374
TOTAL	18,173,589	64,940,081	71,177,066

TABLE II.—DISTRIBUTION OF EXPORTS OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

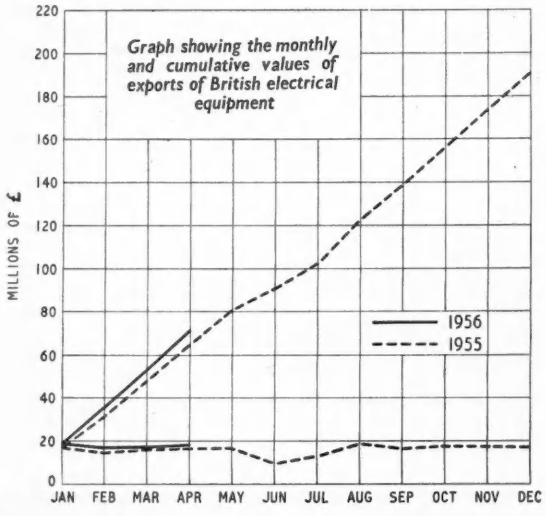
Country	April, 1956	Four months ended April, 1955	Four months ended April, 1956
	£	£	£
Channel Islands	88,359	207,936	317,220
Gibraltar	123,314	107,725	166,323
Malta and Gozo	50,692	248,245	292,841
Cyprus	161,447	398,392	618,722
Sierra Leone	16,867	126,144	100,131
Gold Coast	107,001	510,906	579,644
Nigeria	261,451	1,016,874	1,201,464
Union of South Africa	1,198,890	6,966,882	5,424,883
Rhodesia and Nyasaland	407,737	1,606,471	2,195,575
Tanganyika	68,971	325,699	243,192
Kenya	291,293	601,982	942,078
Uganda	98,245	387,447	305,936
Anglo-Egyptian Sudan	147,113	403,501	326,314
Mauritius	34,799	131,380	110,350
Aden	55,576	221,196	223,926
Bahrain, Qatar and Trucial States	95,817	304,580	377,610
Kuwait	179,098	369,515	455,604
India	1,746,774	5,509,668	6,895,600
Pakistan	230,870	1,280,597	1,073,403
Singapore	356,635	1,404,422	1,216,969
Federation of Malaya	298,018	1,007,095	1,119,776
Ceylon	178,061	463,489	613,001
British North Borneo	8,138	111,269	114,063
Sarawak	23,662	86,323	87,281
Hong Kong	233,001	655,161	792,100
Australia	1,922,307	7,004,834	7,253,287
New Zealand	934,560	4,873,657	3,694,140
Fiji	15,100	102,490	66,874
Canada	813,248	2,382,862	3,097,782
Jamaica	118,047	297,739	461,325
Barbados	12,762	76,842	121,891
Trinidad	79,400	375,227	435,159
British Guiana	39,035	199,165	163,504
Other Commonwealth countries	66,702	518,024	305,491
Irish Republic	286,484	1,276,000	1,187,712
Soviet Union	335,042	693,516	1,147,278
Finland	134,879	414,530	561,773
Sweden	285,030	1,338,477	1,231,395
Norway	184,921	1,274,469	779,842
Iceland	14,838	45,179	58,338
Denmark	162,395	532,619	667,835
Poland	15,526	88,831	122,429
Western Germany	174,052	584,920	703,633
Netherlands	592,022	2,266,664	2,307,225
Belgium	231,759	875,992	1,087,479
France	295,093	981,100	1,222,515
Switzerland	69,612	284,101	358,051
Portugal	284,643	1,007,575	754,385
Spain	413,619	466,092	914,792
Italy	286,115	773,497	1,240,896
Austria	32,833	113,742	173,044
Yugoslavia	13,856	333,424	266,363
Greece	421,033	481,109	892,580
Turkey	86,105	400,683	356,529
Belgian Congo	31,653	143,960	133,474
French Morocco	38,938	128,979	177,858
Portuguese East Africa	18,342	77,749	92,172
Egypt	159,862	494,220	698,308
Libya	35,272	64,059	92,418
Syria	83,617	126,853	212,729
Lebanon	40,762	124,744	188,110
Israel	37,301	153,589	223,281
Jordan	23,684	122,140	191,570
Saudi Arabia	24,864	305,759	282,603
Iraq	355,039	956,572	1,349,887
Iran	188,186	267,025	809,665
Burma	103,912	715,918	600,083
Thailand	61,306	612,901	407,355
Indonesia	67,732	97,534	222,170
Japan	54,020	316,557	207,292
United States of America	968,624	1,476,576	3,261,529
Cuba	22,438	105,710	116,486
Mexico	79,799	109,621	266,217
Colombia	74,486	397,598	389,347
Venezuela	297,005	1,219,859	1,312,243
Peru	41,863	161,064	173,125
Chile	25,738	182,757	91,321
Brazil	303,041	175,463	1,008,645
Uruguay	5,747	147,506	32,275
Argentine Republic	83,401	682,185	272,084
Other foreign countries	164,110	1,056,924	943,266
TOTAL	18,173,589	64,940,081	71,177,066

(£297,858). Greece took equipment of this kind valued at £277,045.

There was a rise in the demand for telegraph and telephone material from £1,270,418 in March to £1,498,407 in April, the principal Commonwealth purchaser being Australia with a value of £256,881. The leading foreign buyer was Portugal which took equipment valued at £141,294. There was a small increase in the demand for electric cables, wires, etc., the total for April of £2,836,776 comparing with £2,641,227 for the previous month. The April, 1955, figure was £2,247,038. In Table II the exports of equipment included in Table I are analysed according to destination.

Exports of other electrical products not shown in Table I are included in the official returns. These include electric washing machines, the exports of which in April were valued at £297,326 (against £278,303 in April, 1955) up to 150 lb net weight; £116,709 (£150,404) over 150 lb net weight; and £71,899 (£47,510) for parts. Exports of electric light fittings and lanterns, complete, with or without lamps, were valued at £160,018 in April (against £123,987 in April, 1955), electric locomotives at £127,934 (£215,846), and i.c. engine locomotives with electrical transmission at £861,394 (£434,278).

There was a fall in imports of electrical equipment as compared with the previous month, from £2,078,135 to £1,910,562, but the April figure was still higher than that of £1,766,196 for April, 1955. The United States was again the principal supplier with a value of £558,257, second place being taken by Western Germany which supplied goods valued at £356,584 and third place by the Netherlands with a total of £335,647.

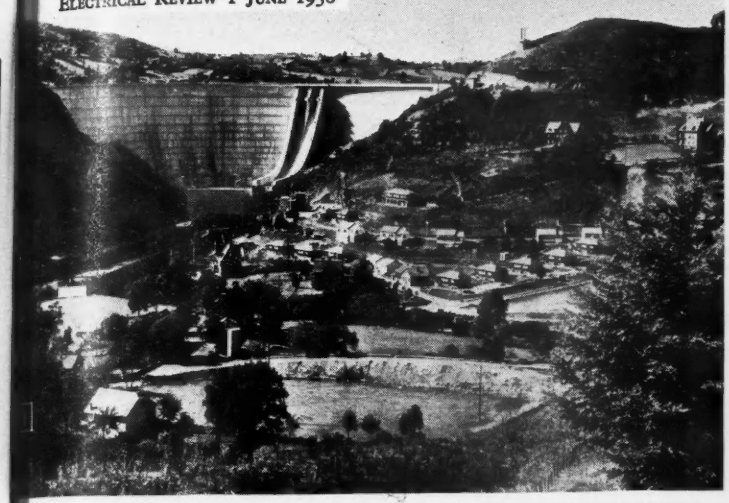


Large Electric Systems

THE sixteenth biennial Conference on Large Electric Systems (C.I.G.R.E.) opened in Paris on Wednesday and continues until Saturday next week. Dr. R. A. Schmidt (Lausanne) is president and Mr. J. Tribot Laspiere vice-president and delegate-general. Of the 117 papers to be submitted 14 are being presented by authors from the United Kingdom, two from Australia, four from Canada, one from Ireland and one from South Africa.

In addition to visits to places of interest during the conference, post-conference tours lasting two or three days have been arranged, including visits to hydro-electric works on the rivers Dordogne, Rhône and Rhine, some of which are illustrated on the facing page.

A report of the proceedings at the conference will appear in the next two issues of the *Electrical Review*.



C.I.G.R.E.

POST-CONFERENCE TOURS

Hydro-Electric Plants in France

1. *Dam at Bort-les-Orgues and power station equipped with two 100 MVA sets*
2. *Chastang Dam on the Dordogne River. The associated power station has three 90 MW turbines installed*
3. *Génissiat on the Rhone. One of a group of 23 plants, which when completed in 15 years' time will have an aggregate capacity of 2,720 kVA producing 4,000 million kWh yearly*
4. *André Blondel 300 MW power station on the Donzère-Mondragon section of the Rhone Valley project. It contains six 50 MW 107 r.p.m. Kaplan turbines with helical wheels and movable blades*
5. *Approaches to Brommat underground works in Dordogne district*

INDUSTRIAL NEWS

Chelsea Flower Show

The E.D.A. stand at the Chelsea Flower Show, held last week, linked up with the popular radio programme "Home Grown," and showed an amateur greenhouse with the electrical equipment which has been given prominence by Roy Hay. The equipment included thermostatically controlled tubular heaters, and a new feature was the installation of a thermostatically controlled ventilating fan for cooling the greenhouse in summer. There was a covered bench across one end of the house and low voltage soil warming was used for two side borders. An electric soil steriliser together with hedge and lawn trimmers, and an electric tiller and its saw attachment, were also exhibited.

Import Quotas

Licensing arrangements for the global import quotas for the second half of 1956 for goods (other than paper, board and paper making materials) still subject to the import restrictions imposed in November, 1951, and March, 1952, are announced by the Board of Trade in Notice to Importers No. 782 issued by the Import Licensing Branch. As in previous periods, the quotas will be allocated on the basis of trade in a past period, and, in general, the licensing arrangements, the principal countries concerned, and method of applying for licences, will remain unchanged.

Batteries for Russian Trawlers

Each of the twenty diesel trawlers being built for Russia by Brooke Marine, Ltd., will be equipped with steel-alkaline emergency batteries by Nife Batteries, of Redditch, Worcs. In the event of failure of the normal electricity supply, the batteries automatically maintain an emergency lighting load of up to 25 A for a period of at least two hours. Each 24 V battery is made up of 20 Nife cells having a capacity of 80 Ah at the 5-hour rate.

New M-V Apprentice Hostel

For many years the majority of candidates for professional engineering training at the Trafford Park works of the Metropolitan-Vickers Electrical Co., Ltd., have come from homes outside the Manchester area, and accommodation has been found in lodgings in the vicinity of the works. There is, however, a great need to increase the number of candidates from public schools and grammar schools, and to facilitate this the company has decided to build a new hostel that will provide accommodation initially for approximately 200. A site, known as Tyntesfield, has been found in Sale, Cheshire, four miles from the works. The hostel will be of modern design, and in its construction care will be taken to preserve the amenities of the well-wooded site. It is hoped to have the hostel available for those who commence their training in September, 1958.

Transatlantic Telephone Cable

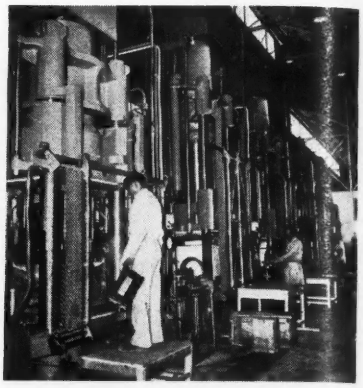
Speaking at the Canadian Chamber of Commerce luncheon in London last week Dr. C. Hill, the Postmaster-General, referred to the increased communications traffic between the United Kingdom and Canada. He said that the great event of this year would be the opening of the first transatlantic telephone cable before the end of the year. It was a tripartite venture of the British Post Office, the Canadian Overseas Telecommunications Corporation and the Bell Co. of America. The cost would be about £15 million.

Information on Lead

To make the general public better acquainted with the properties of lead, the Lead Development Association is issuing a series of brochures for general distribution. The titles so far published are "Lead Paints To-day," "Lead in Cable Manufacture," and "Lead for Batteries." Printed in two colours on art paper, and graphically illustrated, the brochures describe in simple, easily-read terms, the use of lead for each specific product, and explain why lead is the ideal material. The brochures are available from the Association at Eagle House, Jermyn Street, London, S.W.1.

Chloride Batteries Indian Expansion

A large scale installation of additional plant and equipment has been completed at the Exide factory at Shamnagar, near Calcutta, which enables Chloride & Exide Batteries (Eastern), Ltd., to manufacture the "Silver Exide" battery, as produced by their associates, Chloride Batteries, Ltd., in Britain. The most significant extension to the Shamnagar factory has been the installation, in a specially designed building, of a complete rubber processing plant for the manufacture of battery containers. The building also houses a modern injection moulding machine for the production of vent plugs and other battery components. Steam and electrical energy are generated in a new power station, making the factory fully self-contained, and there is a 5-ton rotary furnace for the recovery of scrap lead, which it is claimed is the first of its kind in India. The manufacture of large numbers of train lighting cells per year is planned



Hydraulic presses producing hard rubber containers for Exide batteries at the Indian factory of Chloride and Exide Batteries (Eastern), Ltd.

to meet the increasing demands of the Indian Railway, and there is a department devoted to the manufacture and assembly of industrial type batteries for power stations and the telephone and telegraph systems. The technical department includes a laboratory for routine testing of raw materials and finished components and a test house incorporating an air-conditioned test room for carrying out temperature-controlled experiments and tests.

Railway Modernisation Contracts

Orders placed by the British Transport Commission in connection with its railway modernisation plan include contracts for 166 power equipments for diesel shunting locomotives. These have been placed with the General Electric Co., Ltd. (45 power equipments) and the English Electric Co., Ltd. (121 power equipments). The locomotives will be built in the British Railways workshops at Derby, Crewe and Darlington.

Metal Industry Handbook

The 1956 edition of "Metal Industry Handbook and Directory" (Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, 15s net) is a comprehensive reference book for all those engaged in, or connected with, the non-ferrous metal industries. It contains up-to-date information on the properties of the newer as well as the more familiar metals, and an extensive section is devoted to summaries of British Standard aircraft material, D.T.D. and Admiralty specifications. The handbook also includes a section on the chief metal finishing processes and data regarding all the common rod, bar, sheet and strip products, while a new feature in this year's edition is a section giving tables dealing with the weight of titanium alloys in sheet, rod and tube.

The directory for buyers is a particularly useful section; it gives a wide range of producers, stockists, and factors of all basic metal products, metal working machinery and tools, and metal finishing equipment.

A complimentary copy of the handbook is issued to all subscribers of *Metal Industry*.

New Automation Company

The General Electric Co., Ltd., and the British Tabulating Machine Co., Ltd., announce that they have entered into arrangements for collaboration in the design of computers and like equipment to cover the field in which such devices can be employed and particularly the sphere of office machinery and automation. They believe that, by collaboration in these matters and the application of specialist knowledge, significant advances in the development of these devices will be made. To implement this policy it is intended to form a new company the capital of which will be held equally by the parent companies. The financial, production and distributing structure of the parent companies will not be affected by this arrangement.

Electricity and Transport

In the summary of Sir John Dalton's presidential address to the British Electrical Power Convention in last week's issue (page 865) reference was made to a table comparing the prospective increase in traction consumption with the present domestic consumption. We regret that the table was inadvertently omitted and now reproduce it below.

Type of Load	Million kWh per annum
Space heating	6,500
Cookers	4,550
Water heating	2,500
Television	990
Radio	510
Traction (expected increase due to new electrification scheme)	1,500

Proposed Indian Company

It is announced that Vickers, Ltd., Babcock & Wilcox, Ltd., and the Associated Cement Companies, Ltd., of India, are carrying on negotiations regarding the possibility of setting up a joint company in India to manufacture cement-making machinery, boiler plant and other engineering products.

Atoms, Electrons and Industry Exhibition

The Electrical and Electronics Section of S.I.M.A. (Scientific Instrument Manufacturers' Association), following the Electronics at Work exhibition at Birmingham, 1954, is this year showing at Bristol some of the latest developments of the instrument industry. The exhibition, entitled Atoms, Electrons and Industry, is to be held at the Royal West of England Academy, Queens Road, Bristol, 8, from 6th to 8th June. The United Kingdom Atomic Energy Research Establishment, Harwell, is displaying some ten exhibits on its stand of the latest research work connected with radio-isotope instrumentation. Professor C. F. Powell, Bristol University, will open the exhibition and the Lord Mayor is to extend a civic welcome. Admission to the exhibition is by ticket only, and applications should be made to the general secretary, Scientific Instrument Manufacturers' Association, 20, Queen Anne Street, London, W.1.

Power from Fusion Conference

The United Kingdom Atomic Energy Authority is holding on 4th June a one-day symposium on controlled thermo-nuclear energy. It will take place at Harwell and will be on a classified basis. Invitations have been sent to representatives of industrial research laboratories in addition to Government research establishments and British universities. The object of the symposium, at which a general account of the Authority's own project will be given, is to encourage fundamental research work along lines which will assist the work of the Authority in this field.

Railway Charges

A revised edition of the "Scale of Standard Railway Charges," has been published by the Railway, Shipping & Publishing Co., Ltd., 12, Cherry Street, Birmingham, 2, price 20s post free. This covers the 5 per cent and $7\frac{1}{2}$ per cent increases of railway charges which came into force on 23rd April. The rates shown cover all classes of goods in Classes 1 to 20, and in addition to the station to station rates, the collected and/or delivered rates are also shown for Classes 11 to 20.

Welding Titanium

We have received from British Oxygen Gases, Ltd., a leaflet giving the findings of research work which has been carried out by the company into the welding of titanium alloys. Many of the normal methods of joining metals can be applied to titanium, although its special chemical and metallurgical characteristics may call for modified techniques. Spot, flash, pressure and fusion welding techniques, suitably modified, can be used to produce sound ductile welds. Brazing is also possible and the technique is being actively developed. Titanium will become contaminated and embrittled on exposure at high temperatures to oxygen, hydrogen and nitrogen. This characteristic eliminates the use of the oxy-acetylene and the metallic arc welding processes, but it renders the inert gas tungsten arc (i.e. Argonarc welding) process eminently suitable.

Recommendations for the production of sound, ductile welds are given in the leaflet and advice on jigging as well. Operating conditions such as current, argon flow, welding speed, etc., for different gauges of the metal are given in tabular form.

Lamp Price Reduction

Philips Electrical, Ltd., announces that the list price of its 8ft 125 W MCFA/U fluorescent lamp is reduced to 25s with effect from 1st June. The lamp is available with bi-pins or B.C. caps in White, Warm White, Cool White (Daylight) and Cool White De Luxe (Natural).

New Ekco-Ensign Fluorescent Lamp

The Ekco range of fluorescent tubes has been extended to include the 125 W 8ft tube, which will be available in white, warm-white, daylight and natural.

"Empress of Britain"

S. O. Bowker, Ltd., inform us that some 5,000 of their Tenby Pilot Series II surface pattern switches and similar accessories have been installed in the *Empress of Britain*. Similar switches have also been specified for installation in the *Empress of England* which was recently launched at Newcastle-on-Tyne by Lady Eden.

Transport of Heavy Equipment

The largest-ever load to leave the Rugby Works of the British Thomson-Houston Co., Ltd., was dispatched on 24th May on a 90-mile journey by road to Meaford "B" power station, near Darlaston, Staffs. The load, weighing 160 tons net and far beyond the limits permissible by rail, was the completely

B.T.H. stator en route for Meaford "B" power station negotiating a difficult corner in Rugby

wound, hydrogen-cooled stator of the second of four B.T.H. 60 MW turbo-alternator sets for this station. With the stator in position on the trailer the overall height of the ensemble was 14ft 9in, width 16ft 9in, length 165ft and the total weight 220 tons. With a 210 h.p. tractor in front and two smaller ones employed at the rear on severe gradients the overall length of the coupled vehicles was over 180ft. The load reached its destination on 27th May.

I.T.A. Yorkshire Station

Marconi's Wireless Telegraph Co., Ltd., has been awarded the contract for the construction of the Independent Television Authority's second Northern television station. This, to be built at Emley Moor, near Huddersfield, is, like the London and the Winter Hill stations, a "turnkey" project for Marconi's, the company being responsible for the entire station, comprising the buildings, transmitters, tower, aerial and feeder systems. Work is now in progress on the site. The technical equipment will be similar to that at Winter Hill.

Scottish Wholesalers' Enterprise

T. Stanley Weston & Co., Ltd., 194, Bath Street, Glasgow, electrical wholesalers, recently held a three-night exhibition introducing trade buyers' and contractors' assistants to all the latest domestic appliances and fittings as shown at the recent British Industries Fair. The exhibition was after normal business hours, which enabled buyers to view goods on display at their leisure.

Electricity in Building

A conference and exhibition on "Electricity in Building" specially arranged by the North Western Electricity Board for builders, architects, decorators, plumbers and others in East and West Lancashire interested in building, was held on Tuesday, Wednesday and Thursday of this week at Blackburn. Of particular interest was an address by Mr. A. F. S. Wright on "Electric Floor Warming Systems."

Lighting Equipment Analysis

Referring to the report of the summer meeting of the Illuminating Engineering Society in the *Electrical Review* of 18th November, Dr. H. H. Ballin (Thorn Electrical Industries, Ltd.) tells us that he opened the discussion on the paper "A Critical Analysis of Lighting Equipment and its Maintenance" by Messrs. J. Mortimer Hawkins and C. J. Veness, and not Mr. Anderson as we stated. Dr. Ballin says he expressed some doubt as to whether the extra expense involved in the adoption of the authors' suggestions could always be justified. The standardisation of control gear, he said, was not in the hands of the manufacturer; customers frequently demanded different shapes and sizes for various purposes. Similar considerations applied to the standardisation of the colours of fluorescent lamps.

In the report of the same discussion Mr. C. A. Hughes of Siemens Bros. & Co., Ltd., feels that our summary does not accurately represent what he actually said. Mr. Hughes says that his comments in the discussion were to the effect that the matters referred to in the paper as requiring attention in the main were refinements which manufacturers would supply if the customer was willing to pay for them. He says he referred to advertisements offering fluorescent fittings at 50s each and that he expressed the view that contractors would not want this sort of article, which could only be unsatisfactory in service, unless it was that some contractors might welcome such things on the score that they would provide future work for contractors in maintaining them in working condition.

Rhodesian Copper Price Reduction

A *Reuter* message from Salisbury, Southern Rhodesia, reports that the mines of the Rhodesian Selection Trust companies (Roan Antelope and Mufulira) have cut their copper prices for Britain for the second time in a month. The new price is £320 sterling a long ton (c.i.f., U.K.) for electrolytic copper wire bars, and takes effect from 28th May. The previous price of £350 had been in force since 30th April.

Profit-Sharing Scheme

Employees of Horace Green & Co., Ltd., received a share in the profits of the company when they attended the annual meeting and profit sharing in the works canteen on 16th May. The dividend paid was slightly less than in the last two years, the average over the 42 years being about 12 per cent on wages paid. Gold watches were presented to two employees in recognition of forty years' continuous service with the company.

Research Vessel Equipment

A 180 h.p. Crossley diesel engine has now been installed in *Lalla Rookh II*, the new Kelvin Hughes research vessel launched on 28th February. This six cylinder engine, which has a maximum continuous power of 162 b.h.p., will give the ship a top speed of 9 to 9½ knots. In addition to the main engine, three auxiliary Crossley diesel engines will be installed to drive pumps and generators. Four generators are being installed; one is coupled to the main engine, which will supply the power required to run the ship and experimental and development equipment. The three auxiliary engines are: One 6 b.h.p. (at 1,000 r.p.m.) driving a Hamworthy air compressor and a general service water pump with a capacity of up to 23 tons/hr; one 8 b.h.p. (at 1,250 r.p.m.) connected to a 24 V 5 kW generator (also driving a Hyland hydraulic pump for operating the winch); one 15 b.h.p. (at 1,000 r.p.m.) to drive two generators (one 5 kW alternator delivering a 240 V 3-phase, 50 c/s supply and one 220 V 8 kW d.c. generator). An additional d.c. generator with an output of 220 V 10 kW will be driven from the tailshaft of the main engine. This generator is designed to give a constant voltage and supply throughout a variable speed range. All generators ordered for *Lalla Rookh II* are to be manufactured by Crompton Parkinson, Ltd.

Annual Holidays

British Insulated Callender's Cables, Ltd., announces that its various works will be closed for the annual holidays during the following periods:—Prescot, Helsby, Melling and Huyton Quarry Works, from 27th July to 11th August; Willenhall Foundry, from 28th July to 11th August; Erith Works, from 21st July to 6th August; Anchor Works, Leigh, from 7th to 14th July and 8th to 15th September. All dates are inclusive.

The offices and works of Lindsay & Williams, Ltd., will be closed for the annual holidays from 28th July to 6th August.

The summer holiday (two weeks) for the employees of the Hoover factories will commence on the following dates:—Perivale, 23rd July; High Wycombe, 27th July; Merthyr Tydfil, Glamorgan and Cambuslang, 30th July. Administration and commercial activities will continue as usual at the factories during those periods.

Export Credits Guarantee Department

The Export Credits Guarantee Department announces that its Bradford office is now at Britannia House, Bridge Street, Bradford, 1 (telephone: Bradford 25147).

Trade Announcements

On and after 4th June the head office of the **Jackson Electric Stove Co., Ltd.,** will be at Dallow Road, Luton (telephone: Luton 5883). The export, heavy duty, contracts and trade sales sections will move to Luton, but the Publicity Department and the London showroom will remain at 143, Sloane Street, S.W.1.

The Metropolitan-Vickers Electrical Co., Ltd., announces that its Swansea sub-office is now at 166, St. Helen's Road, Swansea, and its Edinburgh sub-office at 61a, Queen Street, Edinburgh, 2.

Goodmans Industries, Ltd., has appointed Land, Speight & Co., Ltd., 2, Fitzroy Place, Sauchiehall Street, Glasgow, C.3, as sole distributors for its products in Scotland.

Radiovisor Parent, Ltd., has recently moved its organisation to the new factory at Stanhope Works, High Path, London, S.W.19.

Change of Name

RCA Photophone, Ltd., has changed its name to RCA Great Britain, Ltd.

NEW ELECTRICAL EQUIPMENT

Dissolved Oxygen Meter

A new instrument known as the Baker Hersch dissolved oxygen meter has been produced by BAKER PLATINUM, 52, High Holborn, London, W.C.1. This instrument will continuously and accurately measure the dissolved oxygen in, for instance, boiler feed water, down to very small concentrations—less than 0·005 c.c./litre. It is primarily intended for use in the range 0-0·02 c.c./litre, but it can also be calibrated for measurements up to 0·10 c.c./litre. The speed of response to changes in oxygen concentration is such that oxygen introduced due to a leak or a de-aerator failure will be measured in about one minute of its reaching the sampling point. The meter has no pumps or other moving parts and no electrolyte or other impurities need be added to the water under test, which can consequently be returned to the system.

Mineral Insulated Cable

The C.M.A. mineral insulated cables are now available from all district offices of the EDISON SWAN ELECTRIC CO., LTD., 155, Charing Cross Road, London, W.C.2. These cables are enclosed in solid drawn copper sheaths with one, two, three, four or seven solid copper conductors, and are available in 250 V and 660 V ranges. An interesting feature is the new termination which is cheaper than similar terminations previously offered and incorporates an improved design of the sealing arrangement of the disc into the sealing pot, ensuring an all-round crimp. The tool to perform this operation employs conventional spanners for tightening.

Instrument Housing

An accessory for safeguarding continuous operations involving temperature control from shut-down risks has been introduced by WEST INSTRUMENT, LTD., 52, Regent Street, Brighton. This consists of two units: one is a complete temperature control with hand grips and mounted with a self-aligning plug, and the other is the housing which receives the first unit and provides the matching socket and external wiring terminal block. Gold plated contacts, a wiping action and spring loading in the plug and socket help to assure trouble-free operation. With this plug-in accessory it is possible to replace an instrument very quickly before recordable temperature variations have taken place.

Portable Obstruction Lights

A new system for use in conjunction with their portable obstruction lights has been introduced by LONDEX, LTD., 207, Anerley Road, London, S.E.20. This provides for four extra lights to be operated from one master light, with a consequent saving in initial and running costs.

The equipment is operated by two dry batteries giving several weeks of unattended flashing and it is calculated that this method of marking obstructions costs about one-sixth of a penny per hour for the five lights flashing in synchronism. The light source is a special Londex cold-gas discharge lamp: a natural red tube is normally used for obstructions but green and white are available.

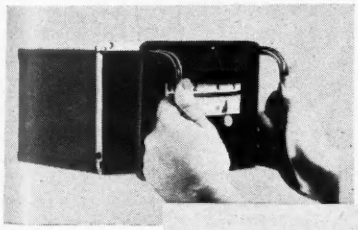
A master unit is supplied complete with a length of cable to a waterproof plug-in socket and thence to a junction box. For interconnecting this to the slave units in a series loop a single core h.v. t.r.s. cable, 7/·029in, is suggested.

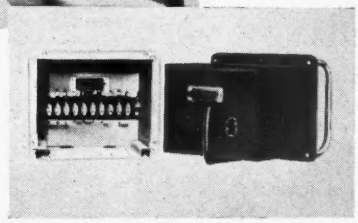
Transformer Radiators

A tangential type radiator for use with transformers has been produced by WASHINGTON ENGINEERING, LTD., Washington, County Durham. A feature of this is the wide cross-sectional area of the upper and lower connecting channels, equivalent to 4in diameter nominal bore tubes. The radiator sections are joined by electronically controlled resistance welding and the radiators are manufactured in any height up to 12ft and up to 20 sections per radiator. They are lightweight and rigid structures and no stretching of the sheet metal takes place when forming the heart-shaped connecting bosses. The bracing straps for the prevention of harmonic vibration are detachable.

Hedge Trimmer Attachment

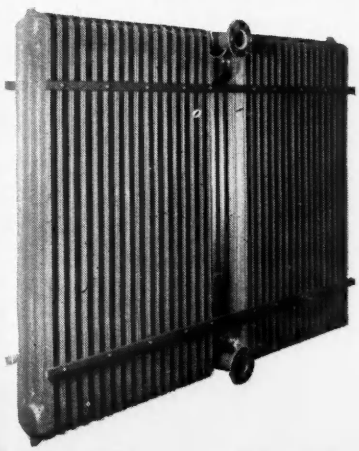
The latest attachment to be added to the range of Wolf "Cub" portable electric tools manufactured by WOLF ELECTRIC TOOLS, LTD., Pioneer Works, Hanger Lane, London, W.5, is a hedge trimmer. Designed for either light trimming or hard cutting back on long hedges it has a blade length of 10in, is of the oscillating type and incorporates a step-down gear reduction giving a speed of 850 strokes per minute. It is attached to the nose of the drill by means of a simple screw clamp and the cutters are operated through a driving dog which is fixed into the power unit driving spindle in place of the ¼in chuck. The weight

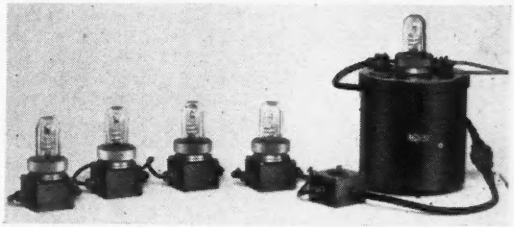




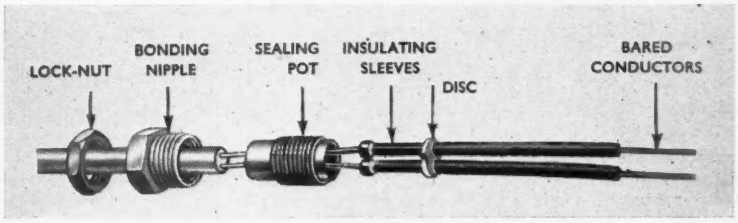
Above: Plug-in temperature control and its housing

Below: Washington tangential transformer radiator

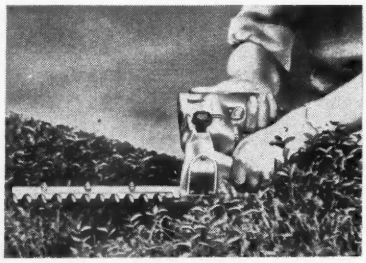




Londex master and slave obstruction lights



Component parts of terminations of C.M.A. mineral insulated cables



Wolf hedge trimmer attachment

Television line selector

"de Mille" vegetable peeling machine

is 2 lb and it is priced at £5 17s 6d. A 30ft length of three-core 23/·0076 t.r.s. extension cable, together with a weather-proof three-pin plug and socket, is also available price £1 19s 6d.

Enlarger Lamp

A new "Photocrescenta" opalised enlarger lamp has been introduced by PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2, and will eventually succeed the current type.

The new lamp is the outcome of a long period of research into filament efficiency, lamp life and envelope design. The development of an entirely new process of flush opalising gives all the even light distribution associated with the original "Photocrescenta" plus greater light transmission and improved heat distribution.

These enlarger lamps are available in the 110, 210, 230, 240 and 250 voltage range and will retail at 3s 9d each for the 75 W size and 4s 9d each for the 150 W size; these prices include purchase tax in the United Kingdom.

Television Line Selector

A new instrument enables any individual line to be selected from a complete picture signal and displayed on a conventional triggered oscilloscope. It is produced by MULLARD, LTD., Century House, Shaftesbury Avenue, London, W.C.2, and can be used on transmitter or receiver circuits for the examination of depth of modulation, d.c. levels, bandwidth, and synchronisation. It provides output pulses of 50 microseconds duration delayed with respect to the frame synchronising pulses and these can be used to initiate the trace of a triggered oscilloscope, the sweeping duration of which is adjusted to display one or more lines of the video signal.

Vegetable Peeling Machine

The "de Mille" portable potato and vegetable peeler, now being produced by NOEL DE MILLE & CO., LTD., 13-15, Lister Road, Hillington, Glasgow, S.W.2, has a capacity of 7 lb and has been specially designed to meet the needs of small hotels, cafés, etc. Although light in weight (18 lb) it is quite robust, rustless and does not require to be bolted down. Construction is of aluminium, finished in white stoved enamel on a red base. A $\frac{1}{6}$ h.p. universal motor is employed to power the replaceable abrasive rotary plate and cylindrical liner, and when in use the extent of the peeling can be observed through the "Perspex" lid. Compact, it measures 16in by 9½in by 13in high, and the price is £29 10s.

Power Transductors

A standard range of power transductors has now been made available by the STURDY ELECTRIC CO., LTD., Burnopfield, Newcastle-upon-Tyne. The range covers units from 10-60 kVA single-phase or 30-180 kVA when connected three-phase, and the range of current variation is normally 10 : 1. It is possible to design them with wider current ranges for special application. The maximum voltage across the load is 90 per cent of the supply voltage and the current in the d.c. windings can be proportioned to suit customers' requirements.

Draw-in Tapes

A new type of packing has recently been introduced by the LEWIS SPRING CO., LTD., 122, High Holborn, London, W.C.1, for their "Ferret" range of wiremen's draw-in tapes. They are now packed in transparent polythene envelopes which are hermetically sealed. This method has many advantages; not only does it prevent the tapes from rusting in storage but they are easier and cleaner to handle and the contents can be readily seen without removal from the package. The range of sizes has been extended to six, as follows:—30, 60 and 100in by ½in wide and 33, 66 and 100in by ¼in wide.

Improved Domestic Cooker

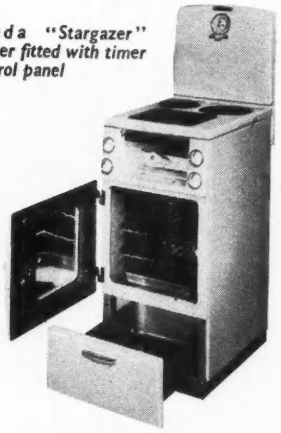
A new version of the Creda "Star" electric cooker, first introduced two years ago, has been announced by the SIMPLEX ELECTRIC CO., LTD., Creda Works, Blythe Bridge, Staffs. It incorporates many improvements, including a glass oven door which is fitted to the plinth and drawer models. Leg models will continue to be fitted with the solid type of door as hitherto.

Other main features of this new cooker, to be known as the "Stargazer," are an improved quality of vitreous enamel, giving a complete colour match between castings and sheet metal components; improved finish to oven interior; chromium plated switch surrounds and "Carefree" type of door handle and surround; base of cooker in hammer grey finish instead of black; and redesigned cooker base, the side panels now extending from hob to base instead of being in two sections as previously.

Hob fittings include a 6½in boiling plate as well as an 8in plate and a grill boiler, the loadings being 1 kW, 2 kW and 2 kW, respectively. The oven is insulated with a blanket of glass fibre wrapped round with aluminium foil which is claimed to give better heat conservation with less bulk round the oven. The oven also includes the "Creda" patented system of heat ventilation, 2,200 W tubular sheathed elements and six-position non-tilt shelves. All the internal corners are rounded, the oven interior sides are removable and the hob lifts off to facilitate cleaning. Fittings include an enamelled grill pan and a large meat tin. The exterior finish is in cream or white.

The price of the standard "Stargazer" cooker is £32 10s and drawer models are £1 15s extra. A timer control panel, which can easily be fitted in place of the normal splash plate, is also available as an optional extra, price £8.

Creda "Stargazer" cooker fitted with timer control panel



NETHERLANDS INDUSTRY

Recovery from War Devastation

By R. E. KAAN, Dipl.Ing.

THE Netherlands, after having suffered the miseries of invasion and occupation by the enemy, was the last European country to be liberated. Her economy was severely impaired by partial destruction of her industry, transport facilities, removals, and insufficient maintenance during the occupation. Industrialisation, hindered in the immediate post-war years by the shortage of skilled labour, raw materials and foreign currency for the import of modern machinery, has since made considerable strides, thus changing the structure of Dutch economic life.

Holland's industrial development is now handicapped more by lack of skilled labour than by absence of investment capital. Many of the registered male unemployed, recently put at about 62,000, belong to the seasonal working classes, who, earning high wages during spring and autumn, prefer to live on social relief during the winter period. At the end of 1955, the general picture of Holland, in spite of this shortage of labour, was favourable. Last year proved to be one of the best; production, personal income, orders, and sales at home and abroad, all reached record levels. Though industrial production increased by 9 per cent over 1954 and by 30 per cent over 1952, the combination of boom conditions with ever-increasing wages and other inflationary tendencies, is causing apprehension.

Within the Dutch economy, apart from the traditional horticultural and dairy products, the goods of one of Europe's largest electronic manufacturers play a vital part. For the year 1955 electrical imports were valued at £49·5 million and electrical exports at £64 million, compared with £39 million and £54·2 million respectively in 1954. By far the biggest proportion of Holland's electrical trade (Table 1) is represented by products either exported or required by Philips, of Eindhoven and Hilversum.

Holland, in spite of being a small country, represents a highly selective market, well worth cultivating. Western Germany and Belgium are the keenest competitors of United Kingdom manufacturers (Table 2); both have the advantage of proximity and similarity of designs and specifications, apart from the customs union between Holland and Belgium. Table 3 clearly shows the market possibilities for electronic equipment, domestic appliances, and, to a certain extent, heavy electrical plant.

In spite of Germany's strong hold upon the Dutch market (Table 4), available evidence would seem to suggest that Holland is still in some respects an unexplored market for British consumer goods. Increased offers of a large range of domestic appliances, carefully adapted in respect of price, style and quality to meet the needs of the market, might well lead to a considerably larger volume of remunerative business being done. The information to be gained from personal visits of British representatives to Holland in order to observe at first hand the quality and the prices of competitive lines, would undoubtedly be a considerable aid in the formulation of successful offers.

The extent to which the Dutch buy abroad is to a certain degree influenced by the intensity of the efforts with which the foreign manufacturer and exporter push their goods and above all by the ingenuity they display in adapting themselves to the requirements of this competitive market. The British exporter should take full advantage of the goodwill of the Dutch towards British products and exert strenuous efforts to increase his share of the trade.

Table 1.—Dutch Electrical Foreign Trade by Products (£000)

Products	1954 Imports	1954 Exports	First 11 mths. 1955 Imports	First 11 mths. 1955 Exports
Motors	2,140	6,515	2,911	9,377
Transformers	1,221	312	866	311
Radio valves	2,479	9,993	3,584	11,347
Radio, TV receivers, chassis	8,893	17,097	9,976	19,525
Amplifiers	211	419	286	586
Transmitters	729	1,768	791	2,355
Telegraph equip.	295	187	261	172
Telephone equip.	1,193	1,238	2,634	1,838
Radio components	137	314	242	279
Voltmeters and ammeters	398	91	458	139
Cables and wires	2,012	—	3,004	—
Insulators	149	16	145	16
Fuses, sockets, plugs and miniature circuit-breakers	1,373	120	1,559	130
Appliances for regulation, protection and distribution	3,498	1,231	3,893	1,935

Table 2.—Dutch Electrical Imports by Country (million £)

Country of Origin	1953	1954	1955
United Kingdom	5·2	6·7	6·9
Austria	0·1	0·2	0·4
Belgium	8·1	10·2	13·5
France	2·1	2·4	2·4
Italy	0·2	0·2	0·3
Sweden	1·6	1·2	1·2
Switzerland	2·3	2·5	2·4
United States	1·8	1·6	2·2
W. Germany	7·6	13·4	18·8

Table 3.—Dutch Imports from United Kingdom 1954/55 (£000)

Product	1954	1955
Generators	626	438
Steam engines and turbines	126	172
Steam condensers	30	45
Motors under 1 h.p.	167	184
Motors from 1 to 250 h.p.	137	208
Motors above 250 h.p.	53	5
Motor parts	89	98
Starting and control gear	119	108
Rotary convertors	32	9
Transformers	73	89
Switchgear and switchboards	235	205
Mercury arc rectifiers	33	75
Arc welding machines	116	63
Resistance welding machines	24	10
Welding electrodes	16	15
Radio and TV equipment	2,219	2,303
Telecommunication equipment	238	342
Commercial instruments	95	90
Scientific instruments	187	214
Electro-medical apparatus	17	6
X-ray apparatus	67	78
Hearing aids	6	9
Washing machines	105	143
Refrigerators and parts	412	433
Vacuum cleaners	81	77
Floor polishers	9	13
Food mixers	12	9
Space heaters	15	19
Flat irons	30	40
Hair clippers and dry shavers	80	75
Fans	113	108

Table 4.—Dutch Electrical Imports from Western Germany (£000)

Product	1954	1955
Motors and generators under 10 kW	527	751
Motors and generators, 10 kW–1,000 kW	343	801
Motors and generators above 1,000 kW	9	16
Complete generating sets	514	325
Steam engines and turbines	339	262
Transformers and chokes	281	312
Switchgear	523	735
Electric welding apparatus and parts	108	180
Industrial furnaces and parts	39	81
Insulators	27	38
Cables	725	1,302
Insulated wires and flex	241	452
Installation material up to 750 V	932	1,253
Refrigeration equipment	194	422
Power tools	255	311
Telephone and telegraph equipment	318	426
Radio, TV transmitters and receivers	3,310	4,342
Electrical equipment for vehicles	681	915
Accumulators	62	75
X-ray apparatus and components	243	326
Electro-medical apparatus	133	163
Industrial and household cookers and boiling plates	52	113
Vacuum cleaners and floor polishers	153	202
Washing and drying machines	762	1,132
Flat irons	70	81

Production Exhibition and Conference

THE second Production Exhibition sponsored by the Institution of Production Engineers was formally opened on Wednesday last week by Mr. Iain Macleod, Minister of Labour and National Service. This exhibition occupied the Grand Hall at Olympia and about 80 exhibitors took part. The aim was to show companies and the public how research and the development of mechanisation had improved production and productivity. Many official and semi-official organisations as well as manufacturers' associations lent their support.

A conference was held in conjunction with the exhibition based on the theme of "Investing in Success." A variety of papers by distinguished speakers dealt with the roles of research, atomic energy, better fuel utilisation, better factory layout, automation, better design, simplification and standardisation, education and training, better human relations, etc.

Many of the stands were occupied by national organisations such as the Trades Union Congress whose exhibit, a purely graphic one, was intended to express the vital interest of trade unions in industrial efficiency and their understanding that the nation's standard of living was inseparable from the way in which it was earned. The European Productivity Agency set up by O.E.E.C. to seek and promote methods of increasing productivity in member countries had an interesting stand which described some of the results achieved through European co-operation. The Agency has encouraged co-operative research on an international basis, standardisation and the exchange of technical information between countries.

The stand of the British Productivity Council gave special prominence to work study and that of the National Industrial Fuel Efficiency Service showed how it was helping industry to increase efficiency in the use of fuel. A large mural display along the whole of one wall of their stand illustrated bad practices both in the boiler house and on the process side.

Mawdsley's, Ltd., demonstrated their a.c. stop-clutch motor which incorporates in the driving end bracket a combined mechanical clutch and brake unit, operated automatically when the stator current is switched on or off. A method is used of producing axial thrust in an a.c. squirrel cage induction motor and the braking effort is applied to the load only, the rotor having been disengaged by the clutch. Such units are finding applications on transfer machines where precise stopping and starting are needed.

The British Tabulating Machine Co. explained in some detail on their stand the procedures involved in applying the "Hec" electronic computer to production control. This computer uses a punched card technique and is a moderately priced data-processing machine of the digital type.

E.D.A. Display

Special attention was paid to the use of electricity for off-peak space heating by the Electrical Development Association which showed examples of floor warming systems and three types of thermal storage space heaters working under time switch control. The merits of electricity for infra-red drying in stoving and enamelling were illustrated, and a 10 kW high frequency induction heater was shown in operation case hardening small parts.

Hoover, Ltd., had a stand showing armature production and demonstrating both old and new methods of construction. This showed how the use of special machines had saved the company hundreds of thousands of production hours over a year.

The use of ultrasonics for the fatigue testing of materials was demonstrated by Mullard, Ltd. The advantage of such a method is that the time taken to complete the test is much less than by conventional ways. The technique is still in the experimental stage and consists of applying stresses to the specimen about 20,000 times per second through the medium of powerful ultrasonic vibrations. Artificial cooling has to be applied to prevent undue temperature rise in the test pieces, for without it a specimen becomes white hot and breaks within a few minutes.

E.M.I. Electronics, Ltd., demonstrated the use of their high frequency induction generators to speed up heating processes which were once virtual production bottlenecks. They also displayed their system of machine tool control, an installation of which at the works of Laurence Scott & Electromotors, Ltd., was described in the *Electrical Review* of 9th December, 1955. On the British Motor Corporation's stand a large illuminated model demonstrated the control of car production and assembly lines by an electronic production unit designed by E.M.I. Engineering Development, Ltd. According to the specification of each unit required, the control issues instructions to the production lines through a time delay unit so that the various components reach the final assembly lines at the required times.

Eleven different commercial applications of research were demonstrated on the large stand occupied by the Department of Scientific and Industrial Research. These ranged from a method for the continuous casting of steel, to a stool for factory workers which lessens body tension and reduces fatigue. It was on this stand that perhaps one of the true objectives of such an exhibition was realised; the firms concerned were all of medium or small size and came from different sections of industry, having as a common factor someone in their organisations quick to seize upon new ideas. Many of the large-scale automatic processes developed and introduced by the giants of industry can have little relation to the needs of the small factories that produce so many of our goods and in this respect the exhibition was a little disappointing.

In opening the exhibition Mr. Macleod said that progress came from an endless succession of small advances and that example was always better than exhortation. The Government believed in full employment but not in frozen employment and industries generally should take a closer interest in the way their actions affected the workers' life outside the factory gates.

B.B.C. Training Facilities

A few days ago we had the pleasure of visiting once again the Engineering Training Department of the B.B.C. at Wood Norton Hall, Evesham, which earlier this year celebrated its tenth anniversary. Since its establishment nearly 4,000 men and women have passed through one or other of its courses of instruction. New buildings have been completed this year, and 200 students can now live there. During 1956 the number attending courses is expected to rise to more than 800. There are nineteen instructors and lecturer-demonstrators.

The training covers both sound and television principles and practice. At present, one-week colour television courses are being given for senior staff from all sections of the B.B.C. Engineering Division. There is also a five-week course for staff in sound broadcasting to qualify them for transfer to television. Altogether there are five main types of course, of which the longest is of twelve weeks' duration: initial entry, promotion, specialist, conversion, and workshop. Training is also given to certain non-engineering staff, known as studio managers, who are responsible in the sound services for the technical control and balance of the programme at studio centres. Staff intended for the sound service are trained to operate and maintain the apparatus, but in television the increased complication of apparatus and greater operational problems have led to a separation of the two functions, students being trained either as operators or as maintenance technicians. A feature of the training technique is the presentation of highly technical information in such a way that it can be readily understood by staff not possessing an advanced mathematical knowledge.

Engineers and Appearance Design

FOLLOWING the annual general meeting of the Institution of Electrical Engineers on 17th May Sir Gordon Russell, C.B.E., M.C., gave a lecture on "Appearance Design." Expressing the view that the best designs came from engineers who had had some æsthetic training, he said he would like every engineer to have a feeling for colour, for pattern, for texture, for the quality of lettering, and for many of those things which came into practically every engineering design. If that was not possible, an industrial designer might work with the engineer in the very early stages.

Many people seemed to think that better design was much more important in consumer goods than it was in heavy industry. He did not agree with that, feeling that in heavy industry there were many cases where large groups of machines could be immensely improved by some co-ordinated thinking in regard to the components which were used with them. It was regrettable that in many of our power stations an architect was called in to "doll up" what ought to be a really good piece of engineering work.

In the discussion that followed, Dr. E. Wilkinson said that for many years he had been of the opinion that, artistically, if a job was designed with a view to its function being satisfactorily performed, it was therefore æsthetically satisfactory as well. Two objects which made him rather doubt that assumption were the gasholder and the helicopter, which he believed to be functionally quite satisfactory, but which everybody would surely agree looked horrible.

Mr. W. Holttum said that any article could usually be modified in regard to colour and texture of surface, but if it went beyond that there was a great danger of pre-conceived ideas interfering with efficiency. He therefore asked whether the principle of functional design should not be given greater emphasis and much greater caution be shown in making any variation of shape as a concession to appearance.

Sir Gordon Russell said that the functional side of any industrial product was the first thing to be considered, but the engineer was often up against a situation in which there were fifty different ways of solving a problem, some of them giving good shapes and some bad. The engineer had to discriminate between them. It was often just as efficient and no more expensive to make a thing a good shape rather than a bad shape.

Replying to a question by Mr. J. A. C. King, the lecturer said that it was extremely difficult to attempt to design for appearance by rule. Certain shapes were bad in certain conditions, but might be good in other conditions. Asked by Mr. E. J. R. Cooke what was the best age at which to send a young man for training and what type of training he should have, he said that the curriculum was so full that it was difficult to know at what stage to give the engineering designer this kind of training. He thought it would have to be a short course in which the engineer mixed with artists and designers so that he could see their point of view. It was the tremendous specialisation of the present time which was so dangerous.

First Calder Hall Pile Working

THE United Kingdom Atomic Energy Authority stated last week that the first of the two atomic piles at the Calder Hall power station had started working on Tuesday, 22nd May, when sufficient uranium had been loaded for the chain reaction to take place and for the initial pile to become self-sustaining. Physics measurements and instrument checks were now taking place and the gradual commissioning of the plant would follow.

The Calder Hall station is to be officially opened by the Queen on 17th October and for the first time in history electricity will then be supplied from a nuclear power station to a national electricity network on a substantial scale.

Calder Hall is part of the Atomic Energy Authority's programme for power stations and is not included in the national programme which envisages the construction of twelve atomic power stations by electricity authorities during the next ten years at an estimated cost of £300 million. The A.E.A. is also building a replica of the first power station on the same site, and another with four reactors at Chapel Cross, Annan, Dumfriesshire. These have the dual purpose of producing electricity and making plutonium for the military programme. Another atomic power station, at Dounreay, Caithness, will have an experimental fast breeder reactor capable of creating more fissile material than it burns.

It was announced last week that the chain reaction at the Calder Hall nuclear generating plant had been started. In this picture can be seen the apparatus for inserting uranium rods into the pile. Physics measurements and checks are now taking place

DOMESTIC ELECTRICAL EQUIPMENT

Coffee Percolators

THE electric coffee percolator, besides its utility and speed of operation, has the additional merit of being an attractive item of domestic electrical equipment which can be used, if desired, on the dining room table, sideboard, etc. With an average capacity of between 1½ and 2 pints, or sufficient for from six to eight coffee cups, it incorporates a 500 W element, usually of the mica-wound type.

Both automatic and non-automatic types are available, the former being fitted with an additional element which keeps the coffee hot after percolation has been completed. Should the percolator be allowed to boil dry a safety cut-out fitted in most models prevents damage.

Many pleasing designs are available. The majority are of copper, finished in chromium, with heat resisting moulded handles and bases. Some manufacturers favour the use of a porcelain material. With this type, the makers claim, the ceramic pot helps to retain the full coffee flavour. Matching coffee sets comprising sugar basin, cream jug, etc., can also be obtained.

The "Cona" Coffee Machine Co., manufacturers of the original glass coffee maker, now include in their range one- and two-pint non-electric kitchen models for use on any type of electric stove or hotplate.

There has been a slight increase in the price of coffee percolators since our last survey of these appliances and to this there must now also be added purchase tax, so that the average price is now between £6 10s and £7 compared with £5 10s a year ago.

Manufacturer	Name or Model	Capacity	Element Loading	Body	Handle	Special Features	Price (excl. tax)	Purchase Tax
BEST PRODUCTS, LTD., Felix Works, Felixstowe, Suffolk.	"Best" No. 2	2½ pt	500 W	Chromium on copper or pastel enamel shades	Black Bakelite	Automatic cut-out, indicator lights, pre-set percolation	£5 17 6 (chromium) £5 8 0 (enamel)	£1 5 9 (chromium) £1 3 8 (enamel)
BULPITT & SONS, LTD., St. Georges Works, Icknield Street, Birmingham, 18.	"Mayfair" 480 S	1¾ pt	400 W	"Swan-cromalin" plated	Black moulded plastic	Automatic re-set safety device	£5 5 0	£1 3 0
	"Dorchester" 450 S	2 pt	400 W	Polished aluminium	Black moulded plastic	Automatic re-set safety device	£3 12 7	£0 15 11
"CONA" COFFEE MACHINE CO., Felden Works, Railway Place, Wimbledon, S.W.19.	"De-Luxe" Table Model, I, II, IIA and III	½ to 2 pt	350 W	Chromium plated zinc stand, glass bowls	Wooden	Accessories include funnels and drainers	£4 11 9 to £5 9 9	£0 19 3 to £1 3 1
	"Rex"	1½ pt	350 W	Cast aluminium stand, glass bowls	Incorporated in body	On-off switch. Obtainable in range of enamelled colours	£8 19 9	£1 17 9
A. D. DAVIDSON ELECTRIC CO., 62-66, Granville Street, Birmingham, 1.	"Davey" C.601	1½ pt	400 W	Chromium on copper	Bakelite	Urn type fitted with tap	£4 14 6	£1 0 9
	"Davey" C.603	2½ pt	500 W	Chromium on copper	Bakelite	Urn type fitted with tap	£5 15 6	£1 5 4
	"Davey" C.606	4½ pt	950 W	Chromium on copper	Bakelite	Urn type fitted with tap	£8 7 6	£1 16 9
	"Davey" C.618	1½ pt	400 W	Chromium on copper	Bakelite	Jug type	£5 2 11	£1 2 7
ELGA PRODUCTS, LTD., Railway Place, Wimbledon, S.W.19.	"Regency" A.35	1½ pt	450 W	Staffordshire pottery	As body	Automatic action. Matching coffee service extra	£5 10 0 £3 3 0 (coffee service)	£1 4 1 £0 13 10 (coffee service)
	"Stardust" A.36	1½ pt	450 W	Staffordshire pottery	As body	Automatic action. Matching coffee service extra	£5 5 0 £2 2 0 (coffee service)	£1 3 0 £0 9 3 (coffee service)
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.	D.5372	1½ pt	400 W	Chromium on copper	Black Bakelite	Automatic re-set safety device	£6 10 0	£1 8 6
HOTPOINT ELECTRIC APPLIANCE CO., LTD., Fletton, Peterborough.	614 PI	8 cups	400 W	Chromium on copper	Black moulded plastic	Safety protection device	£6 0 0	£1 6 4
LINCASS ELECTRIC, LTD., Guildford Street, Chertsey, Surrey.	651	1½ pt	500 W	Chromium plated, black anodised	Black Bakelite	Earthed connector	£4 4 0	£0 18 11
	654	1½ pt	500 W	Chromium plated, black anodised	Black Bakelite	Switched connector	£4 7 6	£0 19 8
PREMIER ELECTRIC HEATERS, Keeley Street, Birmingham, 9.	652	8 cups	400 W	Chromium on copper	Bakelite	Safety protection device, glass top	£6 0 0	£1 6 4

Manufacturer	Name or Model	Capacity	Element Loading	Body	Handle	Special Features	Price (excl. tax)	Purchase Tax
RUSSELL HOBBS, LTD., 1, Bensham Lane, Croydon, Surrey.	"Russell Hobbs"	1 to 2 pt	600 W	Ceramic, primrose, dove grey and green, and contemporary flower decorations	Ceramic	Time control selector. Companion sugar basin and jug extra	£4 4 0 (a.c.) £4 7 6 (a.c./d.c.) £0 11 8 (matching set)	£0 18 5 (a.c.) £0 19 3 (a.c./d.c.) £0 2 6 (matching set)
S.L.R. ELECTRIC, LTD., Welbeck Road, South Harrow, Middlesex.	"Phœnix" CB.6	1½ pt	500 W	Heat-resisting glass	Black Bakelite	Can be used independently on electric hot-plates	£4 7 6	£0 19 9
F. J. TOMLINSON, LTD., Hall Carr Mill, Rawtenstall, Rossendale, Lancs.	"Handy"	2 pt	450 W	Chromium on copper	Veneered wood	Glass top	£4 4 0	£0 18 11

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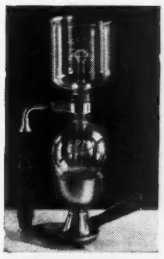
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1. *Bulpitt "Dorchester"*
2. *Hotpoint 614PI*
3. *"Davey" C.601*
4. *Cona "De-Luxe" table model*
5. *Premier 652*
6. *Bulpitt "Mayfair"*
7. *Russell Hobbs coffee pot*
8. *Lincass 651*
9. *"Stardust" coffee service (Elga Products)*
10. *Elga "Regency"*
11. *G.E.C. D.5372*
12. *F. J. Tomlinson "Handy"*
13. *S.L.R. "Phœnix" CB.6*
14. *"Best" No. 2*

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Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

THE performance, ageing properties, tendency to sludge etc., of insulating oils depend mainly on their composition and the latter, in turn, on the refinement process. As even highly refined mineral oils are mixtures of many different hydrocarbons, this accounts for a practically unpredictable number of possible chemical reactions which may take place in the course of time under the influence of atmospheric oxygen. All these determine the ageing process. A great simplification of this complex and truly unsolvable problem is achieved by considering the oil physically as a dilute solution of polar substances in a non-polar solvent, since this definition still applies to an oil after appreciable ageing and containing polar inhibitors. Debye's method of calculating the dielectric losses of such a solution can then be applied and this enables a characteristic index of the state, or composition, of the oil to be determined. The method is based on the fact that there is in general a one-one correspondence between the chemical state of the solution and a quantity proportional to the orientation component of molecular polarisation. This is not affected by external influences, which are difficult to control, such as water absorption or contamination by solid impurities. The fundamental relation between loss figure and frequency holds for an infinite frequency range, but it is only necessary to measure the variations within a range the limiting frequencies of which are in a ratio $>10^4$.—" Definition of a Characteristic Index of the Composition of Mineral Oils," H. Näcke, *E.u.M.*, Vol. 73, No. 3, pp. 52-61, 1st February, 1956, in German.

H.V. Standard Capacitors

The conditions imposed on standard capacitors for h.v. measurements of capacitance, dielectric losses, voltage amplitudes and for obtaining e.m.f. curves, are getting more and more rigorous, since the safety of operation of e.h.v. installations depends to a great extent on the reliability of such measurements. A basic requirement is the stability of the capacitance of standard capacitors under variations of the temperature and humidity of the ambience, and of the frequency and amplitude of the voltages impressed. As a matter of course, standard capacitors should be practically free of losses, or have negligibly small loss angles, if solid dielectrics are used. Another condition is that external fields must not affect the capacitor parameters, and the obvious requirements of satisfactory breakdown strength, chemical stability and long service life. Air-filled capacitors have the disadvantage of large dimensions, which is one of the reasons why either compressed gases or solid dielectrics are preferred, for example, special glasses with loss angles as low as tan $\delta = 0{\cdot}001$-$0{\cdot}002$.

In the voltage range up to 10 kV, ceramic capacitors replace air-filled standard capacitors with great success and take up hardly more than 1 per cent of the volume of the corresponding air-filled type. However, single ceramic units cannot be used for much higher voltages, mainly for technological reasons (up to about 15 kV). Although evacuated capacitors of molybdenum-glass have superior characteristics and can be used up to 150 kV, their lasting properties are unsatisfactory because the vacuum sealing deteriorates. The most satisfactory types are nitrogen and elegas-filled capacitors, the body of which consists either of bakelised paper or porcelain sealed by washers of vacuum-rubber. They have a very favourable volume/capacitance ratio, and the required lasting properties, and the capacitance variation with pressure variations is negligible, tan $\delta < 1 \times 10^{-4}$. Development work on capacitors of this type for voltages greater than 100 kV is proceeding.—" Gas-Filled Standard Capacitor for 100 kV," N. P. Bogoroditskii, N. M. Reinov and Yu. S. Chernev, *Elektrichestvo,* No. 1, pp. 68-71, 1956, in Russian.

Corona Theory

The author deals with the equivalent circuits on which the consideration of systems in corona conditions is usually based and shows that the relations for the voltage of corona inception and of brush discharges may be derived without the knowledge of the capacitance between elements of the insulator surfaces which, in any case, has no well-defined physical meaning. More suitable types of equivalent circuits are therefore suggested which are founded on clearer physical concepts. The equivalent circuit for electrostatic corona inception is theoretically derived and not simply assumed, as usual; it also considers the shapes of poles (e.g. flanges, etc.). The second type of equivalent circuit introduced permits the independence of the critical brush-discharge voltage of the shape of the pole to be demonstrated.

The suitability of these equivalent circuits is confirmed by the agreement of the theoretical results obtained by their aid with experimental results. On the other hand, the theoretical investigations also indicate promising directions for future experimental work on corona.—" Theory of Corona Discharges," V. Chura, *Elektrotechnicky Obzor,* Vol. 45, No. 1, pp. 21-24, 1956, in Czech.

Capacitor Breakdowns

Medium-voltage capacitors the scrolls of which are series-connected are endangered by the puncture of a single scroll, even if it is fused. When the fuse isolates the damaged scroll, the parallel-connected scrolls of the same packet are under an overvoltage which may set up an arc, the gas evolution of which may burst the capacitor casing. Alternatively, the fuses of all the scrolls may blow, the capacitor current be interrupted and full system voltage appear across the capacitor terminals. The ensuing arc will obviously be even more dangerous and may ignite the insulating oil of oil-insulated capacitors with subsequent even more serious damage to the installation. Such dangers may be avoided if an external arrangement of protective relays is used which is based on the comparison of the star-point voltages of two elements of the system, responds to the breakdown of a single scroll, and efficiently protects not only the remaining parts of the installation, but even the affected capacitor itself, since it can be reconstituted by replacement of the punctured scroll.—" Prevention of Capacitor Breakdowns." P.Hochhäusler, *E.T.Z.(B),* Vol.8, No.1, pp.4-7, 21st January, 1956, in German.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review.*

STREET LIGHTING

THE Minister of Housing and Local Government authorised local authorities to borrow £698,372 for public lighting during the quarter ended 31st March last.

Some 109 miles of roads in WANDSWORTH have now been relighted with a total of 5,289 sodium lamps. Altogether the Council's plans for relighting the borough at a cost of £836,000 call for a total of approximately 12,234 lamps but owing to restrictions on capital expenditure the remainder of the scheme has been postponed. The Highways Committee reports that if the old systems were still in operation throughout the borough the annual charge for maintaining gas and electric lighting at present intensities would have amounted to £159,000 as compared with the estimated annual maintenance charge of £75,000 for sodium lighting, a reduction of £84,000. "In accomplishing this reduction," states the Committee, "the Council will also contribute to the nation's economy by ensuring a reduction in the consumption of coal amounting to 7,200 tons per annum."

BLACKPOOL Finance Committee has recommended that the Highways Committee should be required to limit capital expenditure on street lighting in the year ending 31st March, 1957, to a sum not exceeding £50,867.

SHIPLEY Highways and Buildings Committee has received a letter from the divisional road engineer of the Ministry of Transport stating that general conversions of street lighting from gas to electricity must be postponed for the time being owing to the pressing need to reduce capital expenditure. He has, however, supported loan sanction of £1,440 for 30 lamps in Gaisby Lane and 18 lamps in Westfield Lane to secure traffic safety.

Metrovick "SO Fifty" lanterns, with 140 W sodium lamps, mounted on Concrete Utilities columns in Park Road, Hampton Hill. This is part of a £200,000 Group "A" and "B" street lighting scheme. The installation was planned by the borough engineer of Twickenham, the sub-contractors being the North Midlands Engineering Co., Ltd.

Tower truck developed by the South Western Electricity Board for the maintenance of public lighting columns. The top working platform is fitted with safety rails which are collapsible in order that the vehicle may negotiate the low railway bridges in the area

The first phase of a £7,600 street lighting scheme for the BUDE-STRATTON urban district, recently switched on by Mr. T. S. Petherick, chairman of the Council, covers the main roads and town centre; stage two embraces the more important streets and residential centres, and stage three the remainder of the area.

WATFORD R.D.C. has approved in principle a scheme estimated to cost £10,000 for the provision of sodium lighting in four major roads at South Oxhey.

FOLKESTONE Corporation is recommended to approve a scheme, estimated to cost £22,000, for the conversion of 770 gas street lamps to electricity. The work is to be spread over four years.

LUTON R.D.C. is to improve street lighting at Houghton Regis at a cost of £3,300.

STALYBRIDGE Council proposes to proceed with the final stage of its scheme for the conversion of lighting in the remainder of the Castle Hall, Stamford Park area, and Stonecliffe area, etc., from gas to electricity at an estimated cost of £6,300.

A revised scheme for the conversion of side street lighting in GREENWICH from gas to electricity is estimated to cost £112,799.

The borough engineer of WREXHAM has prepared a scheme, estimated to cost £6,000, for street lighting improvements.

BEDFORD Highways and Sewerage Committee proposes to install fluorescent lighting along part of the A.6 trunk road at an estimated cost of £8,000.

The borough engineer of JARROW has prepared a scheme for the installation of another 51 street lamps at a cost of £4,400.

LARNE (Antrim) R.D.C. has approved a scheme, estimated to cost £12,782, for fluorescent street lighting at Greenisland.

Power Prospects in Ontario

Dr. R. L. Hearn, chairman of the Ontario Hydro-Electric Power Commission, told a joint meeting of the Ontario Municipal Electric Association and the Association of Municipal Electrical Utilities recently that by about 1965 water-generated power would contribute less than half of the electrical power needs of Ontario. The Commission had recently completed studies of power demands up to 1980, Dr. Hearn said, and by that time the demand was expected to reach 21,900 MW, with total resources of 23,600 MW. Of this amount, only 5,500 MW would be supplied by hydro-electric generating plants. Conventional fuel-electric plants would provide 10,600 MW and almost 7,500 MW would come from nuclear-electric generating sources. Dr. Hearn said that it had taken the Commission 50 years to develop within Ontario a peak capacity of 4,200 MW, or less than one-seventh what would be needed in the next 25 years.

A sign of the times was the addition of a 200 MW unit to the Richard L. Hearn plant on Toronto's waterfront. This plant was originally designed for four 100 MW turbines and the new unit would be the largest steam turbine generating unit yet installed in Canada. Dr. Hearn also revealed that while this work is going on, provision would be made for two similar installations in the near future which would give the plant a total capacity of 1,000 MW.

Primary power demands throughout Ontario increased by 14·3 per cent during the past year, or more than 500 MW. Estimates of future consumption might be conservative, for the projection provided for increases of little more than 6 per cent per annum, whereas the increase for the last five years had averaged 8·2 per cent. To meet the situation, the Commission was going ahead with two additional 75 MW units at Niagara Falls; the 200 MW addition to the Hearn plant; a 54 MW development at Whitedog Falls, and a total of 31·5 MW to come from Alexander and Cameron Falls.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 6th June from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

25007. General Electric Co., Ltd.—Electric incinerators. 27th October, 1952. (749991.)

1952

7581. Young, S. G.—Snap-action electric switches. 24th June, 1953. (749994.)

15784. Parsons & Co., Ltd., C. A.—Heating units for combustion turbines. 28th May, 1953. (749904.)

20287. General Electric Co., Ltd.—Multiparty signalling systems. 12th June, 1953. (749998.) 28105. Party line telephone systems. 29th September, 1953. (750000.)

29472. Philips Electrical Industries, Ltd.—Methods of metal plating non-conductor. 21st November, 1952. (749824.)

32604. Standard Telephones & Cables, Ltd.—Electric frequency dividers. 17th April, 1953. (749827.)

1953

3091. Sperry Corporation.—Method of making grids for electron-discharge devices. 3rd February, 1953. (749830.)

4856. Junghans Akt.-Ges., Geb.—Electric clocks. 20th February, 1953. (750004.)

4886. Electric & Musical Industries, Ltd.—Radar automatic tracking circuits. 22nd February, 1954. (750005.)

5372. Coughtrie, Ltd., J. & G.—Bulkhead lamps. 8th March, 1954. (750087.)

5569. Standard Telephones & Cables, Ltd.—Electrical control circuits. 19th February, 1954. (749832.)

5589. Breuning, E.—Method of and apparatus for indicating, or actuating, a control device in consequence of a breakage in materials of low electrical conductivity such as textile. 27th February, 1953. (749833.)

8700. Remington Rand, Inc.—Electronic system for computing and otherwise handling information. 30th March, 1953. (749836.)

10577. Standard Telephones & Cables, Ltd.—Telecommunication exchange systems. 9th April, 1954. (750091.)

13254. Hopkinson Electric Co., Ltd.—Dynamo-electric machine yokes. 12th May, 1954. (749839.)

13570. Kabushiki-Kaisha Chuo Seisakusho and Kasugai, Y.—Rotary brush type commutator convertors. 14th May, 1953. (750093.)

17040. Standard Telephones & Cables, Ltd.—Electrical control circuits for electrostatic precipitators. 11th June, 1954. (750013.)

17052. Patent-Treuhand-Ges. für Elektrische Glühlampen.—Base attachment for electric lamps, discharge tube and the like. 19th June, 1953. (750096.)

18568. British Telecommunication Research, Ltd.—Electrical signalling systems. 27th May, 1954. (750097.)

19208. Philips Electrical Industries, Ltd.—Anisotropic permanent magnet alloys. 3rd September, 1954. (750015.)

21120. Ferranti, Ltd.—Electrical terminal chambers. 7th September, 1954. (749848.)

21313. Gera Corporation.—Grid structure for gas filled electric-discharge devices. 31st July, 1953. (750098.)

22876. Brown, Boveri & Co., Ltd.—Magnetic induction accelerators. 19th August, 1953. (749851.)

23817. English Electric Co., Ltd.—Electro-magnetic relays and circuits incorporating such relays. 27th August, 1954. (750019.)

24494. Marconi Instruments, Ltd.—Power assisted mechanisms. 3rd September, 1954. (749855.)

27071. Western Electric Co., Inc.—Electron-discharge devices. 2nd October, 1953. (750021.)

29153. Cole, Ltd., E. K., and Knipe, A. R.—Magnetic sound recording and reproducing arrangements in kinematograph projectors. 22nd October, 1954. (749868.)

29229. British Thomson-Houston Co., Ltd.—Reaction chambers. 22nd October, 1954. (749920.) 29230. Fuel supply systems for reaction chambers. 22nd October, 1954. (749921.)

30811. General Electric Co., Ltd., and Martin, K.—Electric fuse bases and fuse boards. 29th October, 1954. (749872.)

32542. Siemens Electric Lamps & Supplies, Ltd.—Mounting of lanterns for tubular electric lamps. 19th November, 1954. (749880.)

33209. Siemens-Schuckertwerke Akt.-Ges.—Closed magnetic cores for controllable saturable inductors, magnetic amplifiers or like controllable devices. 30th November, 1953. (750109.)

33832. Marconi's Wireless Telegraph Co., Ltd.—Pulse and saw tooth wave generators. 22nd July, 1954. (749883.)

33860/1. Hoover, Ltd.—Squeeze dryers. 15th November, 1954. (750025-6.)

34759. Philips Electrical Industries, Ltd.—Methods of manufacturing thin metal wires or ribbons by etching. 14th December, 1953. (749889.)

35635. Pestarini, J. M.—Excitation system and control therefor. 29th November, 1954. (749894.)

36018. Crabtree & Co., Ltd., J. A, Morgan, R. W., and Thomas, C.—Covers with captive screws, such as for electrical accessories. 23rd August, 1954. (750028.)

1954

1020. General Electric Co., Ltd., and Partridge, J. H.—Shaped glass articles and the manufacture thereof. 13th January, 1955. (749924.)

1048. Soc. per Azioni Bassani.—Electric snap-action switches. 13th January, 1954. (749925.)

4377. General Electric Co., Ltd.—Electric incinerators. 27th October, 1952. (750038.)

5210. Estaugh, W.—Apparatus for transmitting and receiving telephonic and high frequency currents through concentric cables. 20th January, 1955. (750040.)

5964. Bendix Aviation Corporation.—Transducers. 1st March, 1954. (749930.)

7296. Philips Electrical Industries, Ltd.—Radio receivers. 12th March, 1954. (750048.)

13903. General Electric Co. Electric-discharge devices. 12th May, 1954. (749947.)

14192. Philips Electrical Industries, Ltd.—Radio transmitters for frequency-shift telegraphy. 14th May, 1954. (750061.)

15035. Metropolitan-Vickers Electrical Co., Ltd.—Radar aerial systems. 21st May, 1954. (750062.)

17980. Maurer Soc. Anon., A.—Internally cooled electrodes for electric resistance furnaces. 18th June, 1954. (749960.)

19309. Philips Electrical Industries, Ltd.—Electric cables. 1st July, 1954. (749966.)

20157. Benjamin Electric, Ltd.—False ceiling and lighting screen constructions. 9th July, 1954. (749968.)

20205. Vacuumschmelze Akt.-Ges.—Production of laminated magnetic cores. 9th July, 1954. (749969.)

25598. Simon-Carves, Ltd.—Electrostatic precipitators. 3rd September, 1954. (750072.)

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 16th June:—

CON-ELECTRON. No. 747,694. Class 9. Electric time switches, electric relays and electric time-registering apparatus.—Consolidated Electronics Industries Corp., New York, U.S.A. Address for service, c/o Cruickshank & Fairweather, 29, Southampton Buildings, Chancery Lane, London, W.C.2.

No. B746,954 (design). Class 9. Domestic electrical appliances and parts.—Rotary, Paris, France. Address for service, c/o A. A. Thornton & Co., Napier House, 24-27, High Holborn, London, W.C.1.

VISIGARD. No. 748,575. Class 9. Electrical and electronic apparatus for controlling the operation of oil burning apparatus and for giving warning of failure in such apparatus.—Rheostatic Co., Ltd., 94, Farnham Road, Slough, Bucks.

PANASCAN. No. 749,367. Class 9. Electrical apparatus and instruments; scientific, radio, cinematographic and signalling apparatus, etc.—Panellit, Ltd., Dalston Gardens, Stanmore, Middx.

SELMAR. No. 747,550. Class 11. Electrically heated steam-operated apparatus for cooking and heating foods and beverages.—Espresso Cookers, Ltd., 10, Lincoln's Inn Fields, London, W.C.2.

ACHILLES. No. 748,642. Class 11. Heating elements for electrically heated blankets, for electrically heated mattress overlays and for electrically heated articles of clothing.—T. A. Kily, trading as Achilles Products, 293, Rochdale Road, Todmorden, Lancs.

STUPALITH. No. 743,798. Class 17. Ceramic materials for electrical insulation and dielectric purposes.—Carborundum Co., Ltd., Trafford Park Road, Trafford Park, Manchester, 17.

EPITEX. No. 750,248. Class 17. Insulating materials for use in electrical resistances, condensers, suppressors and similar goods.—Erie Resistor, Ltd., 2, Carlisle Road, The Hyde, Hendon, London, N.W.4.

Catalogues and Lists

MOTOR CONTROL GEAR.—Illustrated brochure describing examples of specialised control gear built in the company's works.—**MTE Control Gear, Ltd.** Leigh-on-Sea, Essex.

OVERHEAD LINE EQUIPMENT.—112-page illustrated descriptive catalogue dealing with overhead line equipment for low voltage and high voltage transmission.—**Pirelli-General Cable Works, Ltd.**, Southampton.

PLASTIC PRE-HEATER.—Descriptive leaflet dealing with the company's new H/6A bench type plastic pre-heater.—**Radio Heaters, Ltd.**, Eastheath Avenue, Wokingham, Berks.

PUMPS.—Descriptive folder giving particulars of type "B-N" stainless steel electrically driven pumps for chemical and process duties.—**Sigmund Pumps, Ltd.**, Team Valley, Gateshead, 11.

RELAYS.—Pamphlet (1288) describing type "F" high-speed multi-contact tripping relays.—**A. Reyrolle & Co., Ltd.**, Hebburn, Co. Durham.

WIRING ACCESSORIES.—20-page catalogue covering the company's range of mercury switches and switch plugs designed for hospital operating theatre installations.—**Wandsworth Electrical Manufacturing Co., Ltd.**, Albert Drive, Sheerwater, Woking.

Broadsheet (237) showing the extended range of the company's "Gridswitches."—**M.K. Electric, Ltd.**, Wakefield Street, Edmonton, London, N.18.

GENERATION AND DEVELOPMENT

Welsh Board not Favoured

The South Wales Electricity Consultative Council has expressed the view that, although practicable, a separate Electricity Board for Wales would result in increased costs. Observing that the precedent of Scotland had been quoted in favour of the establishment of a Welsh Board, the Council points out that the former S.W. and S.E. Scotland Boards both contained important urban and industrial areas. In the case of Wales the addition of the predominantly rural areas of North Wales to South Wales would inevitably impose a burden on the industrial area of Glamorgan and contiguous parts of Monmouthshire and Carmarthenshire.

Commenting on the suggestion that a Board for Wales would proceed more quickly with rural electrification, the Council says there is a body of opinion which holds the view that at the present time too much is being spent in the rural areas and that there is a case for greater expenditure on system reinforcement in urban areas. It is pointed out that there has been a marked increase in the number of complaints of poor voltage over the past six months.

Boards' Sales in April

The latest monthly sales by the twelve Electricity Boards in England and Wales are set out in the accompanying table. The national figures show an increase over April, 1955, of 13·6 per cent, but when corrected for weather conditions and working days (26·92 against 26·59) the increase is 8·2 per cent.

Nile Valley Authority Suggested

When the decision of the Government to give financial assistance to the Egyptian Government for the Aswan High Dam project was debated in the House of Commons recently Mr. Hugh Fraser pressed for the formation of a Nile Valley Authority in which all interested Governments would be represented. Including Lake Tana, he said, the head of water was about 6,000ft compared with the 1,000ft of the Tennessee Valley. The whole conception of the present scheme was bad, and destroyed the joint approach to the use of the Nile. The capital to be spent on the Aswan works alone would be $1,300 million, which would mean difficulty in raising capital for projects in other parts of the Nile.

Supporting the idea of the formation of a Nile Valley Authority, Mr. James Johnson said it could have enormous significance for the people in Ethiopia, Uganda, Tanganyika and Kenya. The future of the world lay in Colombo Plans, Tennessee Valley Authorities and the like.

Mr. Bernard Braine considered that the case for an international authority was unanswerable. Unless the whole Nile Valley were treated as one hydrological unit, the allocations of water being governed by one authority, great ill consequences would follow.

Mr. D. Dodds-Parker, Under Secretary for Foreign Affairs, replying to the debate, said that the experts who advised that the High Dam project was sound were of many nationalities, including advisers of the World Bank and of British firms, among others. It was not a snap decision but the result of years of study and exploration. The cost of the dam and of the civil works would be less than one-quarter of the total cost of £400 million; the rest would go on irrigation, compensation, electric power and so on. Going ahead with this scheme would not affect co-operation between Egypt and other East African Governments. These other Governments were putting forward their proposals but he did not expect difficulties about reaching agreement. Firms of many countries had already shown interest in the project. A British firm of consulting engineers had been engaged and negotiations about finance had been going on many months. The British Government had much in mind the importance of seeing that British firms had an adequate opportunity to participate in this international enterprise. The United States and the British Governments had informed Egypt that they would assist by means of grants towards the cost of the first stages of the work, and an assurance was given by the two Governments that they would later consider sympathetically further financial help to supplement the finance from the International Bank for the scheme as a whole. Arrangements were still being discussed. As to an international Nile Valley Authority, the Government believed that it might well come into being in time, and would welcome it.

Loans to Nationalised Industries

Sir Edward Boyle, Economic Secretary to the Treasury, replying to a question in the House of Commons recently, said that the rates of interest on the advances to the nationalised industries would correspond broadly to those appropriate to Government credit for a comparable period of years. Precise details of the arrangements, including the appropriate terms for repayment, were at present under discussion with the authorities concerned. A statement would be made when the Finance Bill was considered in committee.

Holy Island Residents' Petition

Although the Northumberland County Planning Committee has stated that the erection of overhead lines by the South of Scotland Electricity Board on Holy Island is "wholly unacceptable," the inhabitants of the island feel otherwise. A petition has been sent from the islanders to the Planning Committee to reconsider the matter. It is pointed out that Holy Island already has overhead wires for telephones.

Hungarian Atomic Reactor

According to the Hungarian News and Information Service, the building of Hungary's first atomic reactor has begun on Liberty Hill overlooking Budapest. The reactor station consists of one central building to house the experimental atomic pile given by the Soviet Union, and several laboratories. Soviet technicians are to begin fitting the reactor equipment next spring. The reactor is to be used for research in the industrial, scientific and medical fields.

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for April (million kWh)			Twelve Months Totals Ended 30th April (million kWh)		
	1955	1956	Inc. or Dec. %	1955	1956	Inc. or Dec. %
London	483·3	572·5	+18·5	6,257·6	6,792·9	+ 8·6
South Eastern	308·5	361·7	+17·2	3,787·8	4,228·2	+11·6
Southern	367·9	424·0	+15·2	4,557·1	5,068·9	+11·2
South Western	190·2	215·4	+13·2	2,357·2	2,590·8	+ 9·9
Eastern	483·1	569·5	+17·9	6,110·6	6,740·3	+10·3
East Midlands*	420·7	481·6	+14·5	5,321·2	5,794·6	+ 8·9
Midlands*	561·3	622·7	+10·9	7,106·1	7,594·2	+ 6·9
South Wales*	344·2	361·5	+ 5·0	4,098·7	4,411·6	+ 7·6
Merseyside and N. Wales*	337·0	381·0	+13·1	4,129·8	4,554·8	+10·3
Yorkshire*	553·8	622·4	+12·4	6,894·1	7,540·1	+ 9·4
North Eastern*	321·8	369·0	+14·7	4,028·9	4,330·1	+ 7·5
North Western*	600·1	659·3	+ 9·9	7,598·2	8,023·9	+ 5·6
Total all Area Boards	4,971·9	5,640·6	+13·4	62,247·3	67,670·4	+ 8·7
Direct Supplies by Central Authority	146·0	171·4	+17·4	1,611·6	1,983·7	+23·1
Grand Total	5,117·9	5,812·0	+13·6	63,858·9	69,654·1	+ 9·1
Mainly Industrial Areas*	3,138·9	3,497·5	+11·4	39,177·0	42,249·3	+ 7·8
Mainly Non-Industrial Areas	1,833·0	2,143·1	+16·9	23,070·3	25,421·1	+10·2

* Those in which industrial consumers took over 50% of the total sales in the preceding financial year.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—26th July. Sydney County Council. 100 11 kV outdoor type oil circuit-breaker switching equipments. (E.S.B. 13175/56. Ten/19473.)* 23rd August. Six 3,600 kW rectifier equipments and one d.c. switchboard. (E.S.B. 13174/56. Ten/19464.)*

12th June. Commonwealth Posts and Telegraphs Department. Carrier telegraph equipment. (E.S.B. 12864/56. Ten/19459.)* 3rd July. Television transmission equipment. (E.S.B. 12905/56. Ten/19474.)*

Greece.—15th June. Ministry of Finance. Electrical insulating material. (E.S.B. 13293/56. Ten/19484.)* 18th June. Underground cables and rubber insulated cables. (E.S.B. 13294/56. Ten/19495.)

Horsham.—22nd June. U.D.C. Street lighting equipment. (See this issue.)

India.—14th June. Director General of Supplies and Disposals. L.v. paper insulated cable. (E.S.B. 13131/56. Ten/19454.)*

19th June. Government of Madras, Department of Electricity. Cable and cable boxes. (E.S.B. 13058/56. Ten/19452.)*

London.—17th July. India Store Department. Modification kit No. 1 for wireless set C52 and 315 small rotary transformers. (See this issue.)

Manchester.—25th June. Corporation. Contactor and switchgear for Davyhulme Sewage Works extension. (See this issue.)

New Zealand.—19th June. General Post Office. Eighteen radio transmitter-receivers. (E.S.B. 12810/56. Ten/19430.)*

3rd July. Post and Telegraph Department. 2,000 2-pin starters for fluorescent tubes. (E.S.B. 12739/56. Ten/19435.)*

Newcastle-on-Tyne.—16th June. City Council. 262 140 W sodium lighting lanterns. F. S. Taylor, general manager, Transport and Electricity Department.

North Kesteven.—28th June. R.D.C. Four electrically-driven centrifugal type sewage pumps. Silcock and Simpson, consulting engineers, 10, Park Row, Leeds, 1.

Northern Ireland.—12th June. Ministry of Finance. Electrical installation in the local office of the Ministry of Labour and National Insurance, Corporation Street, Belfast. Ministry of Finance (Room 103), Law Courts Building, May Street.

19th June. Northern Ireland Hospitals Authority. Electrical alterations and additions at Masserene Hospital, Antrim. F. D. Brown & Sons, consulting engineers, 93, Ann Street, Belfast. 16th June. Electrical installation in St. Luke's Hospital, Armagh. J. McCandless, consulting engineer, 6, Murray Street, Belfast.

11th June. Northern Ireland Housing Trust. Electrical installations in 148 dwellings at Braniel, Castlereagh. Offices of the Trust, 12, Hope Street, Belfast.

Portuguese West Africa.—14th June. Luanda Light and Water Service. Electric cable, junction and terminal boxes. (E.S.B. 12619/56. Ten/19418.)*

South Africa.—14th June. Union Tender and Supplies Board. Radio equipment, tools and radio tower. (E.S.B. 12420/56. Ten/19415.)* P.v.c. insulated and sheathed switchboard cable. (E.S.B. 13051/56. Ten/19446.)* Electric test equipment. (E.S.B. 12913/56. Ten/19458.)*

15th June. Durban Corporation Electricity Department. Over-current and earth-fault relays. (E.S.B. 13090/56. Ten/19468.)* Disc type insulators and arcing horns. (E.S.B. 13091/56. Ten/19462.)*

6th June. Stores Department, South African Railways. Busbar support insulators. (E.S.B. 12915/56. Ten/19440.)* 8th June. Overhead track equipment. (E.S.B. 12537/56. Ten/19439.)* 13th June. Ferrous overhead track equipment. (E.S.B. 12916/56. Ten/19448.)*

Southend-on-Sea.—11th June. Borough Council. Electrical installation in Richmond Avenue Junior School. (See this issue.)

Syria.—16th June. Direction d'Irrigation et des Forces Hydrauliques, Damascus. Machinery and apparatus for pumping and generating stations, Yarmonk. (E.S.B. 13004/56. Ten/19428.)*

19th June. Service des Contrats et Marches, Ministry of National Defence, Damascus. Lead batteries. (E.S.B. 13005/56. Ten/19434.)*

Uruguay.—20th June. Administracion Nacional de Combustibles Alcohol y Portland. Three-phase underground armoured cable. (E.S.B. 13231/56. Ten/19463.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this ection is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Bury.—Conversions at old cinema premises, Church Street, to form factory; C.S.K. Plastics, Ltd., moulders, Bambury Street.

Cambridge.—Shops (17) and flats (31), on the Arbury Road estate; city surveyor, Guildhall.

Chatham.—Offices, 42-44, New Road; City Prudential Building Society, Ltd., 131, Park Lane, London, W.1.

Chelmsford.—Five-storey offices and shops, Friars Place; Braddock & Martin Smith, architects, East Gallery, St. John's Church, London, N.W.8.

Chesterfield.—Houses (52), Pevensey estate; borough surveyor.

Consett.—Houses (30), Ebchester; E. Simpkin, U.D.C. surveyor.

Cottesmore.—Primary school; county architect, Oakham, Rutland.

Darlington.—Arcade and 12 shops, Skinnergate; W. Haithwaite, Skinnergate.

Durham.—County schools at Felling, Peterlee, Trimdon, Wallsend (3), Washington, and Wolsingham; and county health centre at Jarrow; county architect, Durham.

Eton.—Farrar House (boys' home) at Eton College (£179,000); H. D. Bowyer, building contractor, Mackenzie Street, Slough.

Gateshead.—Bungalows (74); G. F. Winters, borough engineer.

Guildford.—Factory, Station Meadows estate; Refrigeration (A-Z), Ltd., 4, Mill Lane.

Hendon.—Church, printery and other buildings on the Bittacy House estate; International Bible Students' Association, 34, Craven Terrace, Paddington, London, W.2.

Hereford.—Bank and offices, St. Peter Street and Offa Street; Scriven, Powell & James, architects, King Street.

Hertford.—Dwellings (57), Sele Farm estate; Howes & Jackman, architects, 1, Verulam Buildings, Gray's Inn, London, W.C.1.

Leighton Buzzard.—County secondary school; Keith P. Roberts, architect, 21, Woodstock Street, London, W.1.

London.—Retail store, 301-7, Oxford Road, Mayfair; Dolcis Shoe Co., 7-13, Great Dover Street, S.E.1.

Light industrial workshops and offices, Brick Lane, Stepney; Kennedy Leigh Commercial Properties, Ltd., 43, Middlesex Street, E.1.

Block of flats, 37-45, Moreton Place, Westminster; A. N. Billings, Ltd., builders, Coombe Avenue, Croydon.

Long Sutton.—School for Holland C.C.; Daglass, Ltd., Wisbech, Cambs.

Looe.—Factory and warehouse, Polean; Cornish Products (Looe), Ltd., Pooland, West Looe.

Loughborough.—Crematorium (£38,170); borough architect.

Loughton.—Dwellings (43), Oakwood Hill; Tooley & Foster, architects, Midland Bank Chambers, Buckhurst Hill.

Middlesbrough.—Houses (122) at Pallister Park, police houses (10) at Pallister, and (10) at Thorntree, and children's home at Thorntree; J. A. Kenyon, borough engineer.

Newcastle-on-Tyne.—Flats (852) at Longbenton, for the City Council; William Leech, Ltd., builders, St. James Street, Newcastle.

Factory, Forth Bank; Clodol Industries, Ltd., 37, Lovaine Place.

Factories for Novo-Enterprises and Constables (Newcastle), Ltd.; M. Gatoff, architect, 25, Trafalgar Street.

Northfleet.—County primary school at Shears Green (£91,500); Kent county architect, Springfield, Maidstone.

Portsmouth.—Factory on 15-acre site at Leigh Park industrial estate; Menley and James, Ltd., manufacturing chemists, 120, Coldharbour Lane, Brixton, London, S.E.5.

Rickmansworth.—Large offices (£100,000), for the Ocean Accident & Guarantee Corporation, Ltd., Head Office, 36, Moorgate, London, E.C.2.; G. Walford & Partners, architects, Byron House, St. James' Street, London, S.W.1.

Rushden.—Factory for John White, Ltd., Higham Ferrers; A. Sanders, Ltd., builders, Rectory Road.

Sedgefield.—Modern school for Durham C.C.; P. R. Middleton, architect, 17, Albert Road, Middlesbrough.

Houses, Fisburn (92), Sedgefield (40) and Trimden (36); J. Tarran, R.D.C. surveyor.

Slough.—R.C. church, Langley area; H. Bingham Towner, architect, The Baldrons, High Street, Uckfield.

Snodland.—Houses (104), Ham Hill; T. W. Swan & Son, Ltd., builders, Thomas Road Works, Sittingbourne.

Stanlow.—Administrative offices and canteen for Shell Refining & Marketing Co., Ltd.; Grenfell Baines & Hargreaves, architects, 12, Guildhall Street, Preston.

Sunderland.—Comprehensive school on 10½-acre site at Fulwell; H. C. Bishop, borough architect.

Six shops, Hylton Castle estate; H. C. Bishop, borough architect, Grange House, Stockton Road.

Surbiton.—Block of 32 flats, rear of The Crescent; A. E. A. Prowting, Ltd., builders, 127, High Street, Ruislip.

Upton-on-Severn.—Secondary modern school; Frederick Gibberd, architect, 8, Percy Street, London, W.1.

Wellington (Somerset).—Houses (96), Priory estate (£142,751); U.D.C. surveyor, Council Offices, 35, Fore Street.

West Bromwich.—Factory and offices, Black Lake; M. Firkin, Ltd., 25, Carters Green.

Wolverhampton.—Market centre, shops, offices, vegetable and fish markets, etc. (£460,000); William Moss & Sons, Ltd., contractors, Queens Road, Loughborough.